Labor Market Consequences of Temporary and Permanent Employment Protection Legislation

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Abstract

Partial labor market deregulation has been widely used in Europe as a way to provide flexibility to the labor market. However, its full effects have been ambiguous. To better understand these effects we construct an equilibrium search and matching model of the labor market and examine the labor market impacts of various employment protection legislation policies, including temporary contracts deregulation. We explicitly model fixed-term contracts in an economy with worker and job heterogeneity and propose a novel mechanism for how temporary contract deregulation affects the employment decisions of firms, creating labor market segmentation. We look at the dismissal costs for both fixed-term and permanent contracts as a policy instrument and show how the interactions between temporary contract deregulation and the permanent employment protection legislation affect the unemployment rate, the incidence of temporary employment and the aggregate transition rates from temporary to permanent employment. We further show how differences in dismissal costs across countries lead to differences in the above labor market statistics. The model provides a framework for basic policy evaluation.

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1 Introduction

Employment protection legislation (EPL) has been implicated as one of the reasons for the persistently high level of unemployment in Europe (Lazear (1990) and Hopenhayn and Rogerson (1993)). The liberalization of the laws regulating fixed-term or temporary employment contracts in some European countries has been used as a way to introduce flexibility to the labor market, while keeping strict employment protection rules for permanent contracts. As a consequence, firms have increasingly been using temporary employment in the years after the legal changes took place. Presently, an average of 14.5% of EU employees work under fixed-term contracts (Employment in Europe, 2004). However, the effects of these so called "flexibility at the margin" reforms have been ambiguous.

In particular, fixed-term contracts have had an ambiguous effect on the career prospects of workers on such contracts[1]. This in turn has lead to segmentation of the labor market between workers on stable permanent jobs and workers that move through a succession of temporary jobs with small hope of finding permanent employment. Spain has been often quoted as a country where temporary employment liberalization has led to large labor market segmentation, providing temporary workers with limited and uncertain career prospects (Amuedo-Dorantes, 2000). Apart from reducing stable employment prospects of workers, the "flexibility at the margin" reform in Spain has also sparked efficiency concerns and questions about its effect on labor productivity. One point of concern is the use of fixed-term contracts in jobs where specific human capital investment and stable labor relations are important. Investment in on-the-job training has also been negatively affected by the extensive use of temporary employment. For example, workers on fixed-term contracts had a 22% lower probability of receiving on-the-job training in 1994 than workers on a permanent contract (Dolado, et. al 2002)[2].

In general, there are large variations both in the incidence of temporary employment

[1] The mass protests in France in the beginning of 2006 over the introduction of a flexible two-year employment contract for people under 26 shows the extent to which popular opinion in Europe is doubtful of the beneficial effects of such measures. The Contract Premiere Embauche, or the First Employment Contract specifies a two-year trial period during which the firm can fire a worker on such a contract without explanation. After that two-year period, the contract is automatically converted into a standard permanent employment contract (Economist, 2006).

[2] We do not explicitly deal with this issue here but the more general set up of our model can incorporate such efficiency concerns.

and in the transition rates from temporary into permanent employment across European countries, with the fraction of temporary employment as high as 32% in Spain and as low as 5.2% in Ireland (Eurostat).

In the present study we develop a search and matching model of the labor market, based on the Diamond-Mortensen-Pissarides framework. We aim to explain how employment protection policies affect both the transition rates from temporary to permanent employment and the incidence of temporary employment. We look at the roles fixed-term contracts play in an economy with heterogeneous jobs and workers, where workers differ in their skill level ("high skilled" and "low skilled" workers) and jobs differ in the productivity gain any worker can potentially experience. Also a worker's productivity gain depends on how well the worker is matched with the particular job. We call jobs with a large gain in productivity "high skilled" and jobs with a small gain in productivity "low skilled" jobs. For "high skilled" jobs a "high skilled" worker is, on average, more likely to be a good match than a "low skilled" worker, whereas for a "low skilled" job there is no such distinction, and skill does not influence the match quality. Once a match is formed it takes time for the firm to learn the actual job-worker match quality (and achieve the productivity gain that comes with it).

In this model, firms face a decision problem with two sources of uncertainty: uncertainty about match quality between a job and a worker and uncertainty about productivity shocks to the job. In this setting, one reason firms would hire employees on fixed-term contracts would be to screen them. With imperfect information about how good a potential worker is for a particular job, fixed-term contracts work as "stepping stones" towards permanent employment by providing the firm with more time to gather information about the worker's abilities in relation to the specific job (assessing the quality of the match). Another reason for the use of fixed-term contracts would be to maintain flexibility against potential productivity shocks, in which case firms incur lower dismissal costs if they use temporary workers. For "high skilled" jobs in which a good match with the worker entails a large gain in productivity, fixed-term contracts are used to screen workers, providing firms with a margin for experimentation. For "low skilled" jobs in which match quality is less important, fixed-term contracts provide flexibility against potential productivity shocks rather than serving a screening purpose.

We use this model to examine the effect of a given employment protection policy on the labor market. We look at the steady state equilibrium outcome that the model predicts for some specific labor market statistics (unemployment rate, fraction of temporary employment, transition rate from temporary into permanent employment) trying to match these predictions with the actual labor market statistics in Spain in the 1990s. We then look at how these statistics change depending on the underlying employment protection policy framework (embodied in a set of policy parameters that we consider).

We obtain a number of interesting results. In particular, the effect of decreasing the fixed-term contract dismissal cost depends on the permanent contract dismissal cost. Unemployment levels are much more strongly affected when permanent dismissal costs are low than when they are high. The transition rates from temporary to permanent employment and the fraction of workers on fixed-term contracts exhibit the opposite effect, as fixed-term contract dismissal costs affect them more strongly when permanent contract dismissal costs are high. On the other hand, changing the duration of fixed-term contracts does not influence unemployment but does influence the transition rates from temporary to permanent employment and the fraction of fixed-term contracts.

Finally we attempt to clarify how legislative and institutional differences acorss European countries affect the above labor market statistics in these countries. The model we present is by no means an exhaustive representation of a country's labor market. Nevertheless, it provides a basic framework for analyzing the effect of temporary and permanent employment protection policy on the labor market.

The study is organized as follows. Section 2 gives a brief overview of the related theoretical and empirical literature. Section 3 describes the labor market conditions in Europe and the temporary and permanent employment protection legislative framework. Section 4 presents the set-up of our model and its main assumptions. Section 5 then describes the process of solving for the equilibrium steady state and characterizes the three types equilibria that we will deal with. Section 6 describes the model parametrization and the results of matching data on the Spanish labor market. Section 7 is dedicated to policy experiments and a cross country comparison based on numerical simulations made with the model. Section 8 concludes.

2 Literature Review

Search theory and search and matching models have proved useful in analyzing decentralized markets where agents on both sides try to match with appropriate trading partners. The labor market is an example of such a decentralized market, where it takes time for workers to find the most appropriate working environment or the best wage offer and for firms to find the best match for the created vacancy. Given the nature of the labor market, search theory has been extensively applied to study many of its aspects, including the flow into and out of unemployment, unemployment duration, the dispersion of wages, etc[3].

Initial work on search theory includes Stigler's (1961) model of search for information and McCall's (1970) model of optimal job search in which a worker performs a sequential search for the highest wage according to a reservation wage rule (an optimal stopping rule). McCall's model captures the frictions and informational uncertainties associated with looking for a trading partner in a decentralized market and serves as a basis for most of the search theoretic literature. The problem with such a model is that it is one-sided, since it considers the actions of one individual (the worker) independently of the decisions of entities on the other side (the employers). Subsequent work on two-sided equilibrium search (Diamond (1982), Mortensen and Pissarides (1994)) incorporates the one sided search model into an equilibrium framework allowing economists to look at predictions made about the level of unemployment or the transition rates from unemployment to employment, which is not possible in the one sided framework.

Search theory has recently been applied to questions of labor market policy analysis, including the effect of unemployment insurance on search effort, the equilibrium level of unemployment, minimum wage laws and the effect of employment protection laws on unemployment. A subsection of this literature deals with the effects of temporary employment deregulation on the labor market (Blanchard and Landier (2002), Nagypal (2002), Cahuc and Pastel-Vinay (2002), Casquel and Cunyat (2004))

Pries and Rogerson (2005) develop a search and matching model where firms and workers learn about the quality of a match only after a match is formed. Using this set-up,

[3]Rogerson, et. al (2005) and Pissarides (2000) provide a comprehensive review of the search theoretic literature and its application to analyzing the labor market.

they examine the effects of different labor market policies (minimum wages, unemployment benefits, dismissal costs, and taxes) on hiring practices in order to explain the differences in worker turnover in Europe and the US. They do not, however, deal with temporary employment and the effects of the differential employment protection associated with temporary and permanent contracts.

Blanchard and Landier (2002) explicitly deal with the negative effects of the partial labor reform by focusing on one consequence of the liberalization of temporary employment, namely the reluctance of firms to employ workers permanently because of the increased bargaining power that workers would have in a permanent position given the higher employment protection of a permanent contract. Similarly, Cahuc and Pastel-Vinay (2002) consider fixed-term contracts in a search model where permanent contracts are subject to a dismissal cost and the use of fixed-term contracts is limited to a certain fraction of newly formed matches[4]. Focusing on the effect of fixed-term contract deregulation on the level of unemployment and total welfare, they show that introducing more flexible fixed-term contracts may increase unemployment and reduce welfare when permanent employment protection is very strict.

Lastly, Nagypal (2002) examines how dismissal costs affect average productivity by hindering firm experimentation and the process associated with match-specific learning. She then shows that the negative effects of dismissal costs are mostly removed by the introduction of fixed-term contracts. Her analysis, however, does not take into account the fact that firms differ in the productivity gains they make from match-specific learning, with some firms indeed benefitting from the increased ability to experiment with more workers that fixed-term contracts provide, while other firms benefit mainly from the increased flexibility that fixed-term contracts give[5].

Another strand of the search theoretic literature examines labor market models that include either some form of worker or firm heterogeneity or both. Albrecht and Vroman (2002) look at a labor market in which workers differ in ability and jobs differ in their skill requirements, a "low skilled" job can be done by either type of worker but the "high skilled"

[4]In this framework deregulation of fixed-term contracts is equivalent to increasing the fraction of newly formed matches allowed to use a fixed-term contract.

[5]There have also been a number of non-search theoretic studies of the impacts of fixed-term contract deregulation on the labor market. These include general equilibrium models by Cabrales and Hopenhayn (1997), and Alvarez and Veracierto (2006).

job can only be performed by "high skilled" workers. They find out that two steady state equilibria are possible, one in which "high skilled" workers accept only "high skilled" jobs and another one in which "high skilled" workers accept jobs indiscriminately. In a refinement of the above model, Dolado et al. (2004) show that only the second equilibrium exists when there is on-the-job search, using their model on data of mismatch and job-to-job transitions.

Empirical work on the effects of fixed-term contract deregulation on labor market transitions has also been extensive. Most of the work to date has focused on Spain because of the extremely high fraction of workers on fixed-term contracts there. Guell and Petrongolo (2007) estimate that transition rates from temporary to permanent employment in Spain are below 10% for the period 1987-2002. They also observe a pronounced spike in the conversion rates over time, at 36 months, which is the maximum duration of fixed-term contracts in Spain. The authors also report a difference in the transition rates depending on specific worker characteristics such as age and education as well as across industries (highest in the services and lowest in construction)[6].

Casquel and Cunyat (2004) also perform an empirical analysis of transition rates from temporary to permanent employment in Spain, finding that only about 13% of temporary contracts are converted to permanent ones (1994-1998) with highly educated workers being more likely to get a permanent job than workers with low education. They also find that observable worker characteristics (education, work history, etc.) are the only important factors for predicting transition differences between workers, concluding that fixed-term contracts are not used for screening. However, this conclusion can be made only under the assumption that there is no job heterogeneity, which there clearly is in reality. In fact it is the jobs themselves that are associated with a particular difference in transition rates from temporary to permanent contracts. The difference in worker transitions comes from the type of jobs workers get, which in turn depends on observable characteristics only. Hence, what the authors show is not that temporary contracts are not used for screening but that workers are hired on a particular job based on observable characteristics only. However, once on the

[6] Such a finding supports the claim that there is a differential transition rate of workers across skill categories (which is exacerbated in the Spanish case) with temporary contracts serving as "stepping stones" and a "screening device" for higher skilled workers and as "dead ends" for lower skilled ones.

job, there might actually be screening in place[7].

Empirical studies for countries other than Spain include Booth et al. (2000) for the UK, who find that fixed-term contracts in Britain are mostly used as stepping stones (even though more qualified workers are more likely to get a permanent job) and Hernanz et al. (2004), who show that Italian workers are less likely to find a job than Spanish workers but more likely to get a permanent job. Additional findings for other countries are presented in Section 3.

3 Labor Market Conditions in several European countries

3.1 Overview

Despite efforts on the side of EU institutions to promote the gradual convergence of labor market conditions across the EU by setting ambitious collective targets on the employment rate and other labor market characteristics through the Lisbon and Stockholm agenda, EU members still exhibit large variations in labor market performance (Employment in Europe, 2006). Key among these is the large variation in the rates of employment and unemployment (Table 3.1) across European countries, with some of them successfully managing to achieve low levels of unemployment and high levels of employment, while others continue to have a disappointing unemployment and employment record[8].

3.2 Temporary Employment in Europe

One particular component of variation in labor market conditions is the incidence of temporary employment across European countries. Temporary employment has been on the rise in most European countries in recent years (see Table 3.1). It has been seen by policy makers as a way to provide partial flexibility to the labor market, while maintaining the stricter rules governing the use of the more wide-spread permanent employment contracts. Deregulation of fixed-term contracts was achieved by eliminating the so called causality principle and legalizing their use not only for the previous objective cases (seasonal work and work that

[7] They also argue that labor market segmentation due to fixed-term contract deregulation arises endogenously because of worker heterogeneity, whereas we consider job heterogeneity to be the important factor. Furthermore, the assumption that jobs are all the same leads to the above problematic predictions.

[8] Saint-Paul, 2004 provides a detailed discussion of the reasons why European countries may be diverging in their unemployment experience.

Table 3.1: Unemployment rate and fraction of temporary employment

	Unemployment Rate (%)			**Temp. Employment**[9]**(%)**		
Country	1990	1998	2003	1992	1998	2003
Austria	n/a	4.5	4.3	n/a	7.9	6.9
Belgium	6.6	9.3	8.2	5	8.2	8.4
Denmark	7.2	4.9	5.4	10.7	9.9	9.3
Finland	3.2	11.4	9	n/a	17.4	16.3
France	8.5	11.1	9.5	10.6	13.9	12.7
Germany	n/a	8.8	9	10.5	12.4	12.2
Greece	6.4	10.9	9.7	9.6	12.5	11.2
Ireland	13.4	7.5	4.7	8.8	7.2	5.2
Italy	8.9	11.3	8.4	n/a	8.6	9.9
Netherlands	5.8	3.8	3.7	10.4	13	14.5
Portugal	4.8	5.1	6.3	12	17.2	20.6
Spain	13	15	11.1	34.2	33	31.8
UK	6.9	6.1	4.9	5.9	7.3	6.1

Source: Eurostat, Population and Social Conditions, http://epp.eurostat.ec.europa.eu/

is temporary in nature) but for many other cases that involve work that is more indefinite in nature in order to stimulate employment (Cabralez and Hopenhayn (1997)). The rationale has been that such contracts would serve as "stepping stones" towards more permanent forms of employment, allowing firms to be more flexible in their employment strategy and to incur substantially lower dismissal costs and administrative burdens than in the case of permanent contracts.

This logic has worked well in some European countries (Booth et al., 2002, D'Addio and Rosholm, 2004), while in others it has proved more ambiguous, creating a segmented labor market with employees on temporary contracts unable to find a permanent job and receiving lower wages and benefits than permanent workers (Amuedo-Dorantes, 2000, Dolado et al., 2002). Spain is the quintessential example of a country with a segmented labor market. After the reform of 1984 which eliminated the causality principle in the use of fixed-term contracts the fraction of fixed-term contracts in Spain went up from 11% to more than 30% in the 1990s (Dolado et al., 2002)[10].

[9] Temporary employment includes fixed-term, seasonal, temporary agencies, casual, etc.

[10] Subsequent reforms in Spain, namely the 1994 and 1997 reforms of permanent EPL, have attempted to partially curb the excessive use of temporary employment by relaxing some of the strict regulations governing the dismissal from permanent employment.

3.3 Transitions from Temporary to Permanent Employment

The role of temporary employment in an economy is best understood by investigating the transition rate from temporary to permanent employment. There have been several empirical studies on this issue, a few of which were mentioned in Section 2. It is difficult to conduct extensive and thorough studies on this question, however, because of the nature of the data required for it - a high frequency longitudinal survey of individuals tracing their employment record over several years. Even when such data is available it comes from a single country and so cross-country comparisons become possible only through comparisons of separate empirical studies. Table 3.2 shows a compilation of results from different empirical studies about temporary-permanent transitions for several European countries.

Table 3.2: Transition rates based on individual empirical studies

Country	**Temp.-Perm**	**Temp-Unemp.**	**Time period**	**Source**
Austria	48.3	14.8	1995-1999	Zweimuller (2006)
France	33		1987-1990	Abowd et al.(1999)
Germany	22.5	17	1995-1996	Dekkar Kaiser (2000)
Italy	40.5	15.6	2000-2002	Hernanz et al (2004)
Netherlands	24 (men)	14 (men)	1995-1996	Dekkar Kaiser (2000)
Spain	12.3	23	1987-2002	Guell, Petrongolo (2007)
Spain	11.6	24	1995-1996	Amuedo-Dorantes (2000)
Spain	13.1	18.7	1994-1998	Casquel, Cunyat (2004)
Spain	12.8	35.6	2000-2002	Hernanz et al (2004)
UK	31.2	22.1	1995-1996	Dekkar Kaiser (2000)
UK	25.3		1991-1997	Booth et al. (2002)

Table 3.3 presents the results from a more complete study of transition rates across labor market states based on the European Community Household Panel (ECHP) (Employment in Europe, 2004), an annual survey that includes all members of the EU and hence presents a more complete picture of cross-country differences in transition rates. However, this data is also imperfect, in particular because of the annual frequency of the survey, and the inclusion of any kind of temporary employment and not just fixed-term contracts. This second limitation creates a somewhat inaccurate picture of the transition rates into permanent employment since some temporary jobs are truly temporary (such as seasonal and casual work) and a direct transition into a permanent job is rarely possible for them[11].

[11] This is probably one of the reasons why France and Greece have such low transition rates into permanent employment since in these countries the use of temporary employment is restricted mostly to "objective"

Table 3.3: 1 year labor market transitions based on ECHP (1995-2001)

Country	Move into Employment	Stay in Employment	Temporary-Permanent
Austria	13.5	93.5	50.6
Belgium	9.6	95.4	41.7
Denmark	21.1	92.6	36.3
Finland	20.2	92.2	28.5
France	14.1	92.4	20.7
Germany	13.9	91.5	37.2
Greece	11.2	92.4	28
Ireland	15.5	92.4	38
Italy	9.2	92.9	30.6
Netherlands	15.5	93.7	44.9
Portugal	15.7	94	29.4
Spain	14	89.8	23.5
UK	18.4	92.3	44.5

Source: Employment in Europe (2004)

What is obvious from both Tables 3.2 and 3.3 is that Spain presents a particularly striking case with low transition rates from temporary to permanent employment (23.5% in the ECHP data) and a lower rate of stay in employment (89.8%). This is consistent with the results from other studies that characterize Spain as having a strong case of labor market segmentation. Conversely, countries like the UK, Ireland, the Netherlands and Denmark have a much higher transition rate in terms of transition from temporary to permanent employment (44.5%, 38%, 44.9%, and 36.3% respectively).

3.4 The Role of Employment Protection Legislation

Variation in employment protection legislation (EPL) across European countries can help explain some of the variation in these countries' labor market conditions. In particular the nature of a country's EPL can have an effect on the incidence of temporary employment and the transition rates across labor market states. A measure of the strictness of EPL across countries is the OECD EPL index, which looks at the legislative framework in place in these countries[12]. Table 3.4 shows the temporary and permanent EPL OECD scores for the same European countries that we considered in the tables above. The components of these indices

reasons and so the causality principle has not been eliminated to the same extent as it has been in Spain (See Section 3.4.)

[12]The index has three main components: Strictness of Individual Permanent EPL, Strictness of Temporary EPL and Strictness of legislature concerning collective dismissals. Furthermore, there have been three OECD studies to compare strictness of EPL across OECD countries - 1990 (Grubb and Wells, 1993), 1998 (OECD 1999) and 2003 (OECD 2004).

are also important, in particular the sub-score on Valid Cases for use of Fixed-Term Contract for the temporary EPL index (Table 3.5) since it captures the relative degree of liberalization of fixed-term contracts across countries[13].

Table 3.4: Strictness of EPL

	Strictness of Temporary EPL			**Strictness of Permanent EPL**		
Country	1990	1998	2003	1990	1998	2003
Austria	1.8	1.8	1.8	2.6	2.9	2.4
Belgium	5.3	1.5	1.5	1.5	1.7	1.7
Denmark	1.3	2.3	2.3	1.6	1.5	1.5
Finland	3.3	3.3	3.3	2.7	2.3	2.2
France	3.5	4.0	4.0	2.3	2.3	2.5
Germany	3.5	1.8	1.8	2.7	2.7	2.7
Greece	4.0	4.0	4.5	2.5	2.3	2.4
Ireland	0.0	0.0	0.8	1.6	1.6	1.6
Italy	5.3	4.0	2.5	2.8	1.8	1.8
Netherlands	1.5	0.8	0.8	3.1	3.1	3.1
Portugal	2.3	2.3	1.8	4.8	4.3	4.2
Spain	1.5	2.5	3.0	3.9	2.6	2.6
UK	0.0	0.0	0.3	0.8	0.9	1.1

Source: OECD Database on Labor Force Statistics. Measured on a scale from 0 to 6. 0-most liberal and 6-most strict

Having the OECD indices in mind we can go back to the transition rates data and derive several interesting conclusions regarding the connection between the EPL policy framework and transition rates across employment states. In particular, Spain is characterized by a relatively strict permanent EPL (3.9 in 1990 and 2.6 subsequently[14]) and a more liberal temporary EPL especially regarding the valid causes for use of FTC (with a score of 2). The UK and Ireland, on the other hand, have both more liberal permanent EPL as well as temporary EPL and also high transition rates from temporary to permanent employment as well as high transition rates into employment. Italy is a third extreme with stricter temporary as well as permanent EPL and consequently a low rate of move into employment but also higher rates of stay in employment and transition from temporary to permanent employment. France and Greece, as mentioned in the previous section have low transition rates from temporary into permanent employment but also strict temporary EPL (with a

[13]This score also shows that temporary employment in France and Greece is indeed mostly restricted to objective reasons and hence the low transition rate from temporary to permanent employment that we mentioned in Section 3.3

[14]The biggest drop in that score was due to a drastic decrease of the advanced notice period for dismissal from 48 to 1 days and no other change in legislation.

Table 3.5: Components of OECD FTC index

	Valid Causes for Use of FTC		**Max. Number of Consec. Contracts**		**Max. Duration of FTC (months)**	
Country	1990	1998	1990	1998	1990	1998
Austria	2.5	2.5	1.5	1.5	no limit	no limit
Belgium	0	2.5	1	4	24	30
Denmark	2.5	2.5	1.5	1.5	no limit	no limit
Finland	1	1	1.5	1.5	no limit	no limit
France	1	1	3	2	24	18
Germany	2	2.5	1	4	18	24
Greece	0	0	2.5	2.5	no limit	no limit
Ireland	3	3	no limit	no limit	no limit	no limit
Italy	0.5	1	1.5	2	9	15
Netherlands	3	3	1	3	no limit	no limit
Portugal	2	2	3	3	30	30
Spain	2	2	6	3	36	36
UK	3	3	no limit	no limit	no limit	no limit

Source: OECD (1999) and OECD (2004). For first category: 0 - FTC permited only for "objective reasons" (jobs are temporary in nature); 1 - specific exemptions apply (launching a new activity, worker starts new job); 2 - exemptions exist on both the employer and employee side; 3 - no restrictions

score of 0 and 1 respectively for valid causes of use of FTC), which means that a great number of temporary jobs there are indeed just temporary by nature, with no need on the side of the employer to hire such a worker on a permanent contract.

The Netherlands, presents somewhat of a puzzle, given that it has similar EPL index scores as Spain but very different rates of transition from temporary into permanent employment and for move into employment (at least according to the ECHP data). One explanation for this difference is that even though the legislative setting in the two countries might be the same, the judicial system in the Netherlands functions much more efficiently than in Spain. That would effectively increase the burden to employers of the legislation strictness in Spain (thus increasing dismissal costs)[15]. Inefficiently functioning law enforcement institutions would also effectively decrease the strictness of any temporary EPL in place since it would be harder to enforce the rules regarding who is allowed to work under a FTC (hence eliminating any partial remains of the causality principle).

If we compare the scores of the Netherlands and Spain in the World Bank Governance

[15]According to Cabrales and Hopenhayn (1997) at least 15% of the cases of unfair dismissal are settled through a law suit, in which the employer is found guilty of unfair dismissal of workers in 72% of these cases. In such law suits the burden of the proof falls on the employer who has to show that the dismissal is in fact justified either because of economic or disciplinary reasons. For cases that do not reach court the employer pays a substantial settlement payment to the dismissed employee that is much higher than any severance payments specified in the law (Guell and Petrongolo, 2007).

index (Kaufmann, Kraay, Mastruzzi, 2005) regarding Government Effectiveness (which includes, among others, the quality of bureaucracy and competence of civil servants) and Rule of Law (which includes a measure of the effectiveness and predictability of the judiciary and the enforceability of contracts), we see that Spain has a score of 1.7 for the former and 1.3 for latter, whereas the Netherlands has a score of 2.2 for the former and 1.9 for the latter[16]. This supports the claim that the effective dismissal costs in Spain could be much different than in the Netherlands despite the similar policy framework[17].

4 Model

4.1 Assumptions

4.1.1 Basic Set Up

The model we develop is partially based on Pries and Rogerson (2005) and Albrecht and Vroman (2002). Our model economy consists of workers that search for jobs and firms that create vacancies and try to find the best worker for that vacancy. Workers are not identical and neither are jobs. Workers are characterized by a general human capital or skill parameter $a = \{0, 1\}$, which is perfectly observable[18]. The mass of workers is of measure one, and the distribution of "high skilled" ($a = 1$) and "low skilled" ($a = 0$) workers is exogenous with a fraction p of the workers being of "low skill" and $1 - p$ being of "high skill".

Jobs are also of two types - "high skilled" and "low skilled" - depending on the production technology of each job. The two technologies differ in the productivity gain any worker can potentially achieve (with a "high skilled" job having a larger productivity gain than a "low skilled" job). However, realizing that productivity gain depends on whether the worker is a good match for the particular job. We define *match quality* (and hence a good or a bad match) as a characteristic of a worker-job pair that incorporates both how well the worker fits in the particular working environment of that job and how well the worker learns to perform the specific tasks of the job in a given time period (that is the rate of specific human capital

[16]The governance estimates are normally distributed with mean 0 and variance 1.

[17]We use the observation from this section in our cross-country analysis in Section 7.

[18]This parameter would incorporate observable characteristics like education and experience, specific abilities, etc.

accumulation or *match-specific learning-by-doing* in the terminology of Nagypal (2002))[19].

Hence, it takes time to learn the quality of a worker-job match. Also, a given skill level does not guarantee that a worker would be a good match for a given job, and instead only determines the probability that the worker and the job would be a good match. Upon meeting a potential worker firms have only an imperfect preliminary estimate of match quality[20]. We assume that a firm posting a "high skilled" job would, on average, consider a "high skilled" worker more likely to be a good match for the particular job compared with a "low skilled" worker (hence the labeling of the job type)[21]. This assumption captures the important idea that no matter what the specifics of a particular "high skilled" job are a worker that is better educated and has more experience and specific abilities would usually be more likely to do well on that job than a less educated worker. Nevertheless, even a "high skilled" worker may still turn out not to be a good match for a particular "high skilled" job and hence the match quality may end up bad[22]. In short, even though a firm posting a "high skilled" job can't be certain that a given "high skilled" worker will be a good match for that job, it is certain that the "high skilled" worker is, on average, more likely to be a good match than a "low skilled" worker. Contrary to that, in the case of "low skilled" job, education and specific abilities play no role and both "high skilled" and "low skilled" workers would be equally likely to do well in such a job[23].

We model the above assumptions in the following way[24]:

[19]Nagypal (2002) refers to the process of learning about what we call *match quality* as match-specific learning which incorporates both *match-specific learning-by-doing* and *learning about match quality*. However, we will not differentiate between these two components and simply refer to both as *match quality*.

[20]That estimate includes an assessment of how productive the worker would be on the particular job, how suitable the worker is for that job, etc.

[21]This means that the distribution of the match quality estimate given a "high skilled" worker first order dominates the distribution of the estimate given a "low skilled" worker.

[22]This is consistent with the way firms hire workers based on observable characteristics and after having the opportunity to observe the worker's performance on the job, revise their policy towards that worker accordingly (Altonji and Pierret (2001)).

[23]An example of a "high skilled" and a "low skilled" job in this setting would be a computer programming job and a bar-tending job, respectively, since the productivity gain from having a worker who is a good match for the job is higher in the former than in the latter case. It is much more likely for a worker with higher education to be a good match for a computer programming job than for a less educated one. However, not all highly educated workers are good enough for the computer programming job. Some may be able to learn much faster the specific requirements for the job and to fit in with the working environment better than others. On the other hand, having higher education is not important for a bartending job and although there are people who after on-the-job training would be either very good bartenders or only mediocre bartenders, the gain in productivity from having a good bartender is much lower than the gain in productivity from having a good computer programmer.

[24]Table A.1 in Appendix A contains the main variables and parameters of the model for reference.

1. We assume that match quality Y has a binary distribution[25] $Y = \{l, h\}$;

2. The production technology for the two job types (L and H) is $\pi_H(Y)$ and $\pi_L(Y)$, where Y is the match quality of a given worker-job match. It is such that $\pi_H(h) > \pi_H(l)$ and $\pi_L(h) > \pi_L(l)$ but $\Delta\pi_H = \pi_H(h) - \pi_H(l) > \pi_L(h) - \pi_L(l) = \Delta\pi_L$, or $\Delta\pi_H > \Delta\pi_L$. This captures the idea that the productivity gain from having a match of good quality is greater for a "high skilled" job than for a "low skilled" job. In the extreme case that we will work with, $\Delta\pi_L = 0$ and the actual realization of match quality Y is completely irrelevant to the firm posting a "low skilled" job. For the sake of clarity, we would like to point out that a good match, $Y = h$ is not the same as a "high skilled" job getting a "high skilled" worker or a "low skilled" job getting a "low skilled" worker but is rather a random variable whose distribution might depend on such matchings (as in the case of "high skilled" jobs and workers) but whose exact value is not completely determined by them;

3. Match quality Y is both an inspection and an experience good[26]. It is not perfectly observable when a match is made but rather a signal S is observed which is correlated with Y. The signal S incorporates the firm's estimate of the quality of the match;

4. The value of Y is learned at a time T_α, which is random and is distributed as an exponential random variable with rate α (learning is completely unimportant for the "low skilled" firm given that $\Delta\pi_L = 0$). After the value of Y is learned it stays constant until the job is destroyed;

5. Prior to learning the actual value of Y, the productivity of a worker is the same as the productivity of a worker who is a bad match for the given job, namely: $y_0 = l$ (since initially a worker is not trained for the specific job, etc);

6. The signal S is itself a random variable and comes from some distribution $F_S(.)$ on the [0,1] interval and has the following relation to Y: $P(Y = h|S = s) = s$ and $P(Y = l|S = s) = 1 - s$;

[25] In a more general case Y will be distributed continuously on an interval of the real line.

[26] Pries and Rogerson (2005), Nagypal (2002), and Moscarini (2003) make the same assertion and provide a discussion about the importance of learning about match quality during the first months of a worker's tenure.

7. The distribution of the signal S is different conditional on the type of the worker $a = \{0, 1\}$ and the type of the firm, $i = \{L, H\}$. In particular we assume that

$$S_{L,0} = S_{L,1} = 1 \tag{4.1}$$

$$S_{H,0} = 0 \tag{4.2}$$

$$S_{H,1} = F_S^H([0, 1]) \tag{4.3}$$

Hence, we assume that there is no difference in the signal distribution for a "low skilled" job conditional on worker skill (and given that $\Delta\pi_L = 0$ the signal realization is also completely irrelevant and is always 1). We further assume that for a "high skilled" job a "low skilled" worker would never be a good match (hence the zero probability).

The table below summarizes the probabilities that a given match between a worker and a firm would be of good quality.

Table 4.1: Probability that a particular match would be of good quality

Match (firm type, worker type)	**P(Y=h)**
Match (L, 0)	1
Match (L, 1)	1
Match (H, 0)	0
Match (H, 1)	$s \sim F_S^H([0, 1])$

8. A job may be destroyed by an idiosyncratic productivity shock that arrives with a Poisson rate of λ. The (random) time of a productivity shock - T_λ - is therefore distributed as an exponential random variable with rate λ. Once a productivity shock hits the job becomes unproductive and stays like that forever. Hence every time a productivity shock hits the firm fires the worker thus terminating the particular job[27];
9. The wage rate is determined through symmetric Nash bargaining (see Section 5.3);
10. There is free entry of firms and hence the fraction of "high skilled" and "low skilled" jobs is endogenous in the model, with "low skilled" jobs having a fraction of ϕ and "high skilled" jobs having a fraction of $(1 - \phi)$. The cost of creating a vacancy is k_L and k_H for the "low skilled" and "high skilled" job, respectively;
11. Time is continuous and r is the instantaneous discount rate.

[27] We assume that there is no productivity shock if the job is not matched with a worker.

Before we continue with the rest of the set-up we would like to point out that for the purpose of brevity we would be calling firms that post "low skilled" jobs, "low skilled" firms and firms posting "high skilled" jobs, "high skilled" firms.

4.1.2 Contract types

There are two possible contracts that a firm can offer a worker - fixed-term or temporary (F) and permanent (P). The temporary contract is assumed to last for time T, which is fixed exogenously[28]. It is characterized by a cost of dismissal of c_F, which the firm has to pay if it lays off a worker before the end of the contract or at the expiration of the contract. Also, for later analytical convenience we assume that, provided the job stays productive, a worker stays employed on the fixed-term contract until its expiration. When the job is destroyed, the firm can fire the worker even though the contract might not have expired[29]. Upon the expiration of the contract, the firm may either hire the worker on a permanent contract (with a new renegotiated wage) or fire the worker and search for another one.

The permanent contract never expires but the dismissal cost, c_P, is higher than the dismissal cost from a temporary contract, c_F. The two dismissal costs are modeled as a payment to a third party or a pure waste, which is a common assumption in the literature[30].

4.1.3 Matching

We assume that firms and workers meet according to a constant returns to scale matching function $m(u, v)$, where u is the measure of unemployed workers (both "high skilled" and "low skilled") and v is the measure of job vacancies (again both "high skilled" and "low skilled"). The assumption of a CRS matching function allows us to treat $m()$ as a function of v/u only. We define $\theta = v/u$ and hence $m(u, v) = m(\theta)\, u$. Also workers search only when

[28] This is the pre-specified maximum duration of a fixed-term contract allowed by law.

[29] One can relax this assumption and assume a different contractual framework than this. This would lead to slightly different results in terms of the fraction of fixed-term contracts and the transition rate from temporary to permanent employment in the model economy. However, we leave this for future extensions of the model and will not deal with it here.

[30] The administrative costs of firing a worker, possible lawsuits etc. or unfair dismissal payments that act as a tax on the firm because of wage rigidities are what make these costs be a transfer to a third party. We are not concerned with the part of the dismissal cost that represents a transfer from the firm to the worker since such a type of cost would affect the equilibrium wages but not the equilibrium decisions of firms and workers.

unemployed, that is, there is no on-the-job search.

As we mentioned in Section 4.1.1 ϕ equals the fraction of "low skilled" vacancies. We also let γ be the fraction of unemployed "low skilled" workers[31]. Lastly, we have the following variables:

Variable	**Description**	**Value**[32]
ψ^L	rate of meeting "low skilled" job vacancies	$\phi\, m(\theta)$
ψ^H	rate of meeting "high skilled" job vacancies	$(1-\phi)\, m(\theta)$
ρ_0	rate of meeting a "low skilled" worker	$\gamma\, m(\theta)/\theta$
ρ_1	rate of meeting a "high skilled" worker	$(1-\gamma)\, m(\theta)/\theta$

4.2 Firm's decision problem

Upon meeting a worker a firm has three choices: reject the worker and search for a new one, hire the worker on a temporary contract (F) or hire the worker on a permanent contract (P). We then have the following maximized values for each of these three choices:

V^i - value of a vacant job to a firm posting a job of type $i = \{L, H\}$.

$V_F^i(s, a)$ - value to a firm posting a job of type $i = \{L, H\}$ of hiring the worker of skill a on a fixed-term contract (F) after observing a signal value of s.

$V_P^i(s, a)$ - value to a firm posting a job of type $i = \{L, H\}$ of hiring the worker of skill a on a permanent contract (P) after observing a signal value of s.

$V_P^i(y, a)$ - value to a firm posting a job of type $i = \{L, H\}$ of hiring the worker of skill a on a permanent contract (P) after it learns the match quality $y = \{l, h\}$.

Given that a fixed-term contract has a dismissal cost of $c_F < c_P$ it is intuitive that $V_F^i(s, a) > V_P^i(s, a)$ for any signal value s and hence a firm would always want to hire a new worker on a fixed-term contract first[33] (if it hires the worker at all).

We will restrict our attention to equilibria that have positive sorting of worker and firm type, that is equilibria in which "high skilled" workers accept only "high skilled" jobs[34]. Hence the vacancy value of a "low skilled" job is

[31] u, θ, ϕ, and γ are endogenously determined in equilibrium.

[32] For the first variable we then have that the number of meetings between any worker and a "low skilled" job in a given instant is $\phi m(\theta)u$, and hence $\psi^L = \frac{\phi m(\theta)u}{u} = \phi m(\theta)$

[33] This is also so because in our model workers are indifferent between a fixed-term and a permanent contract. If that were not the case then the firm would hire some workers on a permanent contract directly.

[34] We derive a condition for this equilibrium to hold in Appendix A and we later use it in our numerical simulation.

$$rV^L = \rho_0 \int_0^1 \left(max\{V_F^L(s,0), V^L\} - V^L\right) dF_S(s). \tag{4.4}$$

This is equivalent to

$$rV^L = \rho_0 \int_0^1 max\{V_F^L(s,0) - V^L, 0\} dF_S(s). \tag{4.5}$$

The derivation of the value functions is shown in Appendix A.

We also have the following expressions for the values of hiring a worker on a fixed-term contract and a permanent contract respectively for the "low skilled" job

$$V_F^L = V_F^L(h,0) = \int_0^T \left(\frac{1-e^{-rt}}{r}(\pi_L(h) - w_F^L(h,0)) - e^{-rt}c_F\right) dF_\lambda(T) + \tag{4.6}$$
$$+ e^{-\lambda T}e^{-rT}(q(V^L - c_F) + (1-q)V_P^L),$$

$$V_P^L = V_P^L(h,0) = \frac{\pi_L(h) - w_P^L - \lambda c_P}{r+\lambda}. \tag{4.7}$$

In the first expression, $w_F^L(h,0)$ is the wage rate for a "low skilled" worker on a fixed-term contract and q is the "churning" probability, that is the probability with which a firm posting a "low skilled" job would fire its worker after the end of the fixed-term contract. This probability is important in determining the corresponding steady state equilibrium, with $q = 0$ equivalent to no churning and $0 < q < 1$ representing a mixed steady state equilibrium in which firms posting "low skilled" jobs churn with probability q. Introducing this parameter allows us to see the effect of a particular policy on the behavior of "low skilled" firms. Also, as it turns out for many parameter values there is no steady state equilibrium when either $q = 1$ or $q = 0$ and hence, a value for q, such that $0 < q < 1$ guarantees a steady state equilibrium[35]. In the second expression, w_P^L is the wage rate for a "low skilled" worker on a permanent contract.

The above two expressions are also independent of any signal realization or of the time of learning T_α since we assume that any worker is a good match for a "low skilled" job and so there is no learning involved at all, and productivity is always $\pi_L(h) = \pi_L$. Hence, for the vacancy value of a "low skilled" job we get

[35] As we show in Section 5.6 varying q changes the Nash bargaining solution until an equilibrium obtains.

$$rV^L = \rho_0 \left(V_F^L - V^L\right). \tag{4.8}$$

Hence, a firm posting a "low skilled" job will either always hire workers on a permanent contract ($q = 0$ or "normal" equilibrium as we name it) or always lay off its temporary worker and search for another one ($q = 1$ or "churning" equilibrium) or lay of the temporary worker with probability q, $(0 < q < 1)$ ("mixed" equilibrium). Therefore, there will be three equilibrium outcomes possible for workers hired on a fixed-term contract by a firm posting a "low skill" job, and which of the three outcomes is actually the case will depend on the labor market conditions in our model economy. We discuss these three equilibria in greater detail in Section 5.

Similarly, we have the following expressions for the respective values of the "high skilled" firm[36]

$$rV^H = \rho_1 \int_0^1 max\{V_F^H(s,1) - V^H, 0\} dF_S(s), \tag{4.9}$$

$$V_P^H(s,1) = \frac{\pi_H(l) - w_P^H(s,1) - \lambda c_P + \alpha s V_P^H(h,1) + \alpha(1-s)(V^H - c_P)}{r + \lambda + \alpha}, \tag{4.10}$$

and

$$V_P^H(h,1) = \frac{\pi_H(h) - w_P^H - \lambda c_P}{r + \lambda} \tag{4.11}$$

for the vacancy value, value to a permanent contract when the signal value is s and value to a permanent contract when match quality is $Y = h$. In these expressions $w_P^H(s,1)$ is the wage rate of a "high skilled" worker on a permanent contract given a signal value of s and w_P^H is the wage rate of a "high skilled" worker on a permanent contract when the match quality is $Y = h$.

The expression for the value to a "high skilled" firm of hiring a worker on a fixed-term contract is substantially more complicated than the expressions above and hence in its derivation we would use some simplifying assumptions about the firm's behavior during the time of the fixed-term contract. Based on our assumption about the way a fixed-term contract works (Section 4.1.2) if the firm learns the quality of the match Y before the expiration of the contract ($T_\alpha < T$) and $Y = h$ then the firm keeps paying the worker the

[36] Here, we use the assumption that a worker of "low skill" is automatically rejected by a "high skill" firm because of the assumed distribution for the signal value of such a worker.

initial wage of $w_F^H(s,1)$. Once the contract expires and a productivity shock has not made the job unproductive, the firm hires the worker on a permanent contract. If, however, $Y = l$ then the firm keeps the worker until the end of the fixed-term contract and after that lays the worker off and searches for a new worker[37]. In particular, if $V_F^H(s,1)$ is the value to the firm of hiring a worker on a fixed-term contract when the signal observed is s, we have that

$$V_F^H(s,1) = A_1^H(s) + e^{-\lambda T}(1-e^{-\alpha T})e^{-rT}(s\,V_P^H(h,1) + (1-s)\,(V^H - c_F)) + \\ + e^{-(\lambda+\alpha)T}e^{-rT}max\{V_P^H(s,1), V^H - c_F\},$$

where $A_1^H(s)$ is a conditional expectation whose value depends on s. We derive this expression in Appendix A and show that that it is linear and increasing in s.

4.3 Worker's decision problem

A worker with a given skill level $a = \{0,1\}$ faces a decision problem similar to that of the firm. We consider the following quantities:

U_a - value to a worker of skill level a of being unemployed

$F_a^i(s)$ - value to a worker of skill level a of being employed under a fixed-term contract for a job of type i given a signal value of s.

$P_a^i(s)$ - value to a worker of skill level a of being employed under a permanent contract for a job of type i given a signal vlaue of s.

$P_a^i(y)$ - value to a worker of skill level a of being employed under a permanent contract for a job of type i given a match quality of y.

We can then derive expressions for the above quantities using the same approach as in the firm's decision problem. For the "low skilled" worker we have

$$rU_0 = \psi^L\,(F_0^L - U_0), \tag{4.12}$$

$$F_0^L = \int_0^T \left(\frac{1-e^{-rt}}{r}w_F^L(h,0) + e^{-rt}U_0\right) dF_\lambda(t) + e^{-\lambda T}e^{-rT}(\,(1-q)P_0^L + qU_0), \tag{4.13}$$

and

$$P_0^L = \frac{w_P^L + \lambda U_0}{r+\lambda}. \tag{4.14}$$

[37] In any case, whenever a productivity shock hits, the firm lays off the worker.

For the "high skilled" worker we have:

$$P_1^H(s) = \frac{w_P^H(s,1) + \lambda U_1 + \alpha[s\, P_1^H(h) + (1-s)\, U_1]}{r + \lambda + \alpha}. \tag{4.15}$$

Also,

$$P_1^H(h) = P_1^H = \frac{w_P^H + \lambda U_1}{r + \lambda} \tag{4.16}$$

Similarly, for the value to a "high skilled" worker of a fixed-term contract we have

$$F_1^H(s) = C_1^H(s) + e^{-\lambda T}(1 - e^{-\alpha T})e^{-rT}(s\, P_1^H(h) + (1-s)\, U_1) +$$
$$+ e^{-(\lambda+\alpha)T} e^{-rT}(I(V_P^H(s,1) \geq V^H - c_F)\, P_1^H(s) + (1 - I(V_P^H(s,1) \geq V^H - c_F))\, U_1),$$

where $I()$ is 1 if the inequality holds and 0 otherwise. Given that we assume that "high skilled" workers accept only "high skilled" jobs we have the following expression for the value of unemployment for a "high skilled" worker

$$rU_1 = \psi^H \int_0^1 max\{F_1^H(s) - U_1, 0\} dF_S(s). \tag{4.17}$$

5 Market Equilibrium

We now obtain the equations that will help us solve for the endogenous variables and hence determine the steady state market equilibrium. As we mentioned in the previous section we will focus on three equilibria, i.e. the "normal", "mixed", and "churning" equilibria. We will derive the conditions for the normal equilibrium here and just state the equations that differ for the other two since their derivation is mostly analogous[38].

Given the set up in the previous section the hiring and job acceptance strategies of "high skilled" firms and workers respectively have the following general property: there is a cut-off point on the [0, 1] interval such that for signal values below it no match will be formed and for signal values above it firms will hire workers and workers will accept the job offered to them. We will designate these cut-off points for each type of contract as s_F^H for the fixed-term contract and s_P^H for the permanent contract[39]. These cut off points are such that for $s < s_F^H$

[38] In our derivation of the steady state equilibrium conditions we use an approach similar to Pries and Rogerson (2005), Albrecht and Vroman (2002), and Rogerson et. al. (2005).

[39] As we show in Section 5.3 the cut-off point for the firm is generally higher than the cut-off point for the worker and hence a match will form depending on the firm's cut-off points. Also, we show in Appendix A that these cut-off points are unique.

the firm would not hire the worker and prefer to leave the job vacant until it finds another worker. For $s_F^H < s$ the firm would hire the worker on a fixed-term contract, and later decide whether to hire him permanently or not. For $s_P^H < s$ the firm will hire the worker on a permanent contract (once the fixed-term contract has expired and the firm hasn't learned the quality of the match). We have that

$$V_F^H(s_F^H, 1) = V^H \tag{5.1}$$

that is for a signal value of s_F^H the "high skilled" firm would be indifferent between hiring the worker and keeping the position vacant. Similarly for s_P^H we have that

$$V_P^H(s_P^H, 1) = V^H - c_F. \tag{5.2}$$

Using the above, we get the following expressions for the vacancy and unemployment values of "high skilled" firms and workers respectively

$$rV^H = \rho_1 \int_{s_F^H}^1 \left(V_F^H(s,1) - V^H\right) dF_S(s) \tag{5.3}$$

$$rU_1 = \psi^H \int_{s_F^H}^1 \left(F_1^H(s) - U_1\right) dF_S(s) \tag{5.4}$$

An equilibrium is then a collection of the endogenous variables u, θ, ϕ, γ, s_F^H, s_P^H, $w_F^L(h,0)$, w_P^L, w_P^H, $w_F^H(s,1)$, $w_P^H(s,1)$, U_0 and U_1 (and q in the case of the "mixed" equilibrium) such that the following conditions are satisfied:

1. Free Entry Conditions;
2. Steady State Conditions;
3. Nash Bargaining.

5.1 Free Entry

We assume that there is unlimited free entry of firms such that in equilibrium the value of posting a vacant job of any type equals the respective cost of posting a vacancy, k_i, $i = \{0, 1\}$, that is $V^L = k_L$ and $V^H = k_H$.

5.2 Steady State Conditions

We deal with a steady state equilibrium that is with the long run characteristics of our model economy. The states of the economy are the labor market outcomes of "low skilled" and "high skilled" workers - unemployed, on a fixed-term contract, and on a permanent contract. In equilibrium each state will have some constant fraction of workers of each type (different fraction of workers across states but constant fractions across time). In long run equilibrium each state has the property that the flow into any state equals the flow out of it: *"Flow In = Flow Out"*. However, the fact that fixed-term contracts have a fixed duration necessitates an additional assumption about the steady state, namely that existing fixed-term contracts are uniformly distributed on the [0, T] interval, that is at no single point in time is there a greater number of fixed-term contracts than at any other point. This assumption is reasonable, since in equilibrium one would expect that no specific period of time results in more fixed-term contract being signed than any other. If this assumption holds and there were no productivity shocks then in any given time a fraction of $\frac{1}{T}$ of all fixed-term contracts would expire. In the presence of a productivity shock the fraction of fixed-term contracts that end in any given moment (and hence the rate at which fixed-term contracts end since they are uniformly distributed on [0,T]) would be $\frac{1-F_\lambda(T)}{T}$ since a fraction of $\frac{F_\lambda(T)}{T}$ would have already been terminated previously. Figure 5.1 shows the transition rates from one state into another for the "mixed" equilibrium[40].

5.3 Nash Bargaining and Optimal Match Formation

The last ingredient for the steady state equilibrium is the rule that determines equilibrium wage rates and the optimal cut off points. We assume that wages are set through bargaining between workers and firms. The Nash bargaining solution is commonly used in the literature and we use it in this case as well (Rogerson et al. (2005)). It specifies that each side gets a particular share of the surplus of production above its outside option. The fraction of the surplus that each side gets is exogenously determined and is 1/2 in the case of symmetric Nash bargaining, which we assume to hold. In our set-up there will be three possible stages

[40]The system of steady state equations for the "normal" equilibrium is included in Appendix A. For the other two equilibria, we only include the equations that are different from the "normal" equilibrium equations.

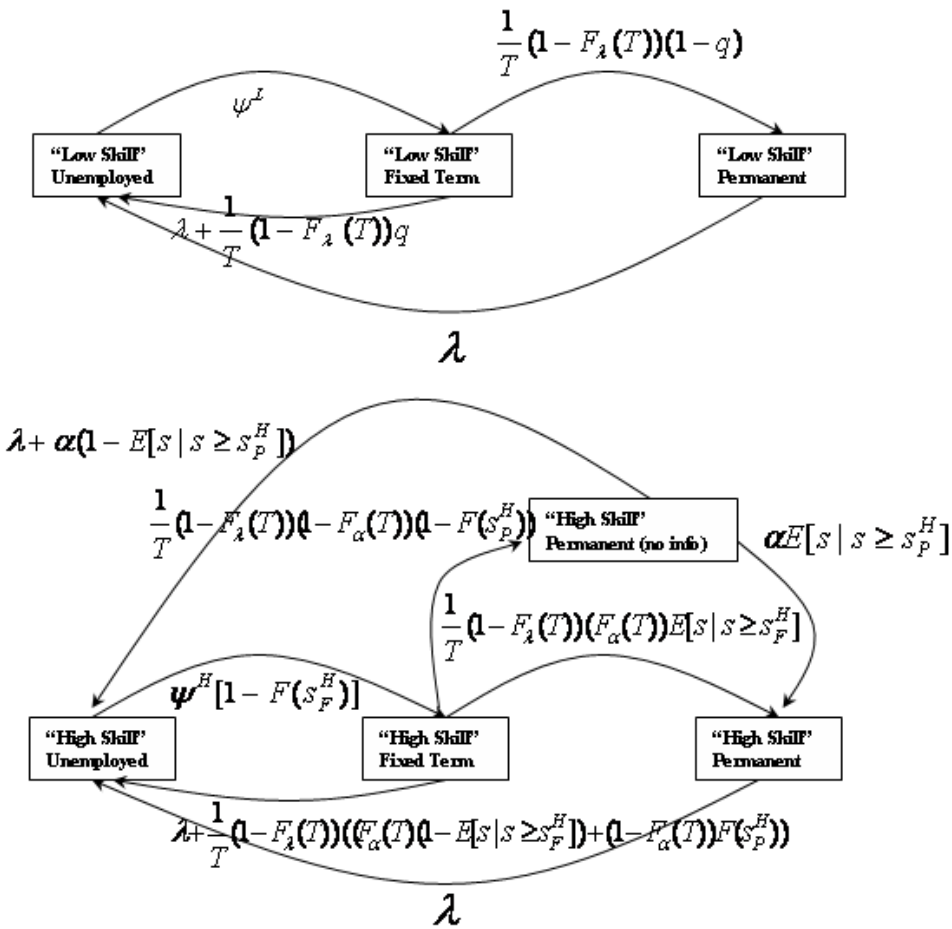

Figure 5.1: Transition Rates from Employment States

of wage bargaining for the "high skilled" job and worker pair - upon signing a fixed-term contract, upon signing a permanent contract with full information about match quality and upon signing a permanent contract with no information about match quality. For the "low skilled" job and worker pair we just have two stages of wage bargaining - upon signing a fixed-term contract and upon signing a permanent contract.

We will work with surplus functions which are the sum of the two values of creating a match for each party minus their respective outside options. The convenience of using surplus functions is that we need not worry about the exact expression for the equilibrium wage rate in these cases (the wage rate will be contingent on the signal S and hence would not be a single value but rather a function of the signal S). For the "low skilled" job and

worker pair we define the surplus function for the fixed-term bargaining stage and for the permanent bargaining stage as

$$SF_0^L = V_F^L + F_0^L - (V^L - c_F) - U_0, \tag{5.5}$$

$$S_0^L = V_P^L + P_0^L - (V^L - c_P) - U_0 = \frac{\pi_L(h) - r(U_0 - c_P)}{r + \lambda} - V^L. \tag{5.6}$$

Similarly, we define a surplus function for the "high skilled" job and worker pair for the fixed-term bargaining stage ($SF_1^H(s)$), for the permanent (no information) bargaining stage ($SP_1^H(s)$), and for the permanent (with information) bargaining stage (S_1^H) as

$$SF_1^H(s) = V_F^H(s,1) + F_1^H(s) - (V^H - c_F) - U_1, \tag{5.7}$$

$$SP_1^H(s) = V_P^H(s,1) + P_1^H(s) - (V^H - c_P) - U_1, \tag{5.8}$$

$$S_1^H = V_P^H(h,a) + P_1^H(h) - (V^H - c_P) - U_1 = \frac{\pi_H(h) - r(U_1 - c_P)}{r + \lambda} - V^H. \tag{5.9}$$

We can then express the values of a fixed-term contract for each job and worker as[41]

$$F_0^L - U_0 = \frac{1}{2} SF_0^L, \tag{5.10}$$

$$V_F^L - (V^L - c_F) = \frac{1}{2} SF_0^L, \tag{5.11}$$

$$F_1^H(s) - U_1 = \frac{1}{2} SF_1^H(s), \tag{5.12}$$

$$V_F^H(s,1) - (V^H - c_F) = \frac{1}{2} SF_1^H(s). \tag{5.13}$$

Furthermore, using (5.1) and (5.2) as well as the above expressions we can determine the optimal cut-off points s_F^H and s_P^H by setting

$$SF_1^H(s_F^H) = 2\, c_F, \tag{5.14}$$

$$SP_1^H(s_P^H) = 2\,(c_P - c_F). \tag{5.15}$$

The reason for these expressions is the following: the firm's outside option prior to signing a contract is V^H but that outside option instantaneously drops to $V^H - c_F$ or $V^H - c_P$ respectively (changing the surplus from $SP_1^H(s) - c_F$ to $SP_1^H(s)$) as soon as the contract is signed and hence the firm would have to give the worker a higher wage than the one agreed

[41] The respective value functions for permanent contracts are analogous only with c_P instead of c_F in the outside option of the firm.

upon initially. Anticipating this, the firm would sign a contract only if the signal value is such that $V_F^H(s,,1) \geq V^H$ or $V_P^H(s,1) \geq (V^H - c_F)$ respectively and hence $\frac{1}{2}SF_1^H(s) - c_F \geq 0$ or $\frac{1}{2}SP_1^H(s) - c_P \geq -c_F$. The worker would like to sign a contract for lower signal values, namely for signal values such that $SF_1^H(s) \geq 0$ or $SP_1^H(s) \geq 0$, but the firm would not agree to sign a contract for these values[42].

5.4 "Normal" equilibrium

From the bargaining conditions above ((5.10) and (5.12)) we have that

$$rU_0 = \psi^L \left(F_0^L - U_0\right) = \psi^L \frac{1}{2} SF_0^L,$$
$$rU_1 = \psi^H \int_{s_F^H}^1 \left(F_1^H(s) - U_1\right) dF_S(s) = \psi^H \int_{s_F^H}^1 \frac{1}{2} SF_1^H(s) dF_S(s),$$

and similarly (from (5.11) and (5.13)) that

$$rV^L = \rho_0 \frac{1}{2} SF_0^L - \rho_0 \, c_F \tag{5.16}$$
$$rV^H = \rho_1 \int_{s_F^H}^1 \frac{1}{2} SF_1^H(s) dF_S(s) - \rho_1 (1 - F(s_F^H)) c_F \tag{5.17}$$

Hence, we have the following expressions for U_0 and U_1 (provided $\rho_0 \neq 0$ and $\rho_1 \neq 0$ which will be the case if $k_i > 0$)

$$rU_0 = \frac{\psi^L}{\rho_0} rV^L + \psi^L \, c_F, \tag{5.18}$$
$$rU_1 = \frac{\psi^H}{\rho_1} rV^H + \psi^H \, (1 - F(s_F^H)) c_F. \tag{5.19}$$

In this way U_0 and U_1 become functions of the endogenous variables and one can substitute for them in the free entry conditions ((5.16) and (5.17)) and conditions that determine the cut-off points s_F^H and s_P^H ((5.14) and (5.15)). These four equations, together with the steady state equations (from Appendix A) determine the "normal" steady state equilibrium[43].

Also in order for the "normal" equilibrium to exist it should always be profitable for a "low skilled" firm to hire a worker on a permanent contract in equilibrium or $V_P^L - (V^L - c_F) > 0$. Since $V_P^L - (V^L - c_F) = \frac{1}{2}\left(S_0^L - (V^L - c_P)\right) - (V^L - c_F)$ we can use (5.6) to obtain

[42] We derive alternative expressions for $SF_1^H(s)$ and $SP_1^H(s)$ in Appendix A, which we use when solving the model numerically.

[43] Provided that the positive sorting condition from Appendix A holds there always exists a unique equilibrium that belongs to one of the three types.

$$\frac{\pi_L(h)}{r+\lambda} - \frac{r}{r+\lambda}U_0 - \frac{(r+2\lambda)}{r+\lambda}c_P - V^L + 2\,c_F > 0 \tag{5.20}$$

5.5 "Churning" Equilibrium

We would not deal with the "churning" equilibrium in our numerical simulations since this equilibrium is attained only for parameter values outside of the range that we consider plausible. However, we will briefly mention it. The conditions for the churning equilibrium are mostly the same as the ones for the "normal" equilibrium apart from the steady state equations for the "low skilled" workers, which for the "churning" equilibrium are

$$\begin{aligned}
&(\lambda + \frac{1}{T}e^{-\lambda T})f_0^L = \gamma u\,\phi\,m(\theta),\\
&\lambda p_0^L = 0,\\
&f_0^L + p_0^L = p - \gamma u.
\end{aligned}$$

Another difference is the value of SF_0^L which becomes:

$$SF_0^L = \int_0^T \left(\frac{1-e^{-rt}}{r}\pi_L(h) + e^{-rt}(-c_F + U_0)\right) dF_\lambda(T) + e^{-\lambda T}e^{-rT}\left(V^L + U_0 - c_F\right) \tag{5.21}$$

Lastly, we have that in equilibrium the following conditions must hold in order for the "churning" equilibrium to exist (it is never profitable for firms to hire workers on a permanent contract):

$$\frac{\pi_L(h)}{r+\lambda} - \frac{r}{r+\lambda}U_0 - \frac{(r+2\lambda)}{r+\lambda}c_P - V^L + 2\,c_F < 0 \tag{5.22}$$

5.6 "Mixed" Equilibrium

For many sets of parameter values, as it turns out, neither the "normal" nor the "churning" equilibrium exists, since either condition for them fails to hold in equilibrium ((5.20) and (5.22), respectively). The rationale for this is simple, the "low skilled" firm's decision to hire a worker on a permanent contract influences the worker's equilibrium outside option, U_0, increasing it when it hires workers on a permanent contract (i.e. in the "normal" equilibrium) and decreasing it otherwise (i.e. in the "churning" equilibrium). As a result the joint surplus from a permanent contract, S_0^L, which is decreasing in U_0 (Eq. (5.6)), goes down in the "normal" equilibrium case (goes up for the "churning" equilibrium) thus making condition

(5.20) (or (5.22), respectively) fail to hold in equilibrium for certain parameter values.

In the "mixed" equilibrium the "low skilled" firm is indifferent between hiring a worker on a permanent contract or laying the worker off[44]. Furthermore, U_0 is decreasing in q (since increasing the probability of churning makes a worker less likely to get a permanent job thus decreasing the worker's outside option). So if $q = 0$ and equation (5.20) does not hold (that is the "normal" equilibrium condition does not hold), increasing q would decrease U_0 until

$$\frac{\pi_L(h)}{r+\lambda} - \frac{r}{r+\lambda}U_0 - \frac{(r+2\lambda)}{r+\lambda}c_P - V^L + 2\,c_F = 0. \tag{5.23}$$

Note that q can increase only until equation (5.23) is satisfied since, if q increases even further so that $\frac{\pi_L(h)}{r+\lambda} - \frac{r}{r+\lambda}U_0 - \frac{(r+2\lambda)}{r+\lambda}c_P - V^L + 2\,c_F > 0$ the "low skilled" firm would be better off not churning at all (since this is the condition for the "normal" equilibrium to hold) but that would in turn increase U_0, which gets us back at where we started. Hence, in equilibrium q will be such that equation (5.23) is satisfied. The situation when $q = 1$ and equation (5.22) fails to hold is analogous[45].

Figure 5.2 illustrates the determination of q in equilibrium when the payoff to the firm of hiring a worker on a permanent contract (V_P^L) equals the payoff from laying off the worker ($V^L - c_F$). q is determined by the intersection of these two curves. Whenever the two curves do not intersect (either $V_P^L > V^L - c_F$ for all values of q or vice versa) then we have either the "normal" or the "churning" equilibrium. Hence these two equilibria can be thought of as arising from corner solutions. Also Figure 5.3 shows how the two curves shift when we both decrease c_P and c_F. Decreasing c_P shifts V_P^L to the left while decreasing c_F shifts $V^L - c_F$ up.

Hence, we have that when there exists a "mixed" equilibrium the "churning" probability q is such that equation (5.23) holds. Furthrmore, the steady state conditions for the "low skilled" worker become

[44] If q is the probability of laying off the worker, the "normal" equilibrium case will be equivalent to $q = 0$ and the "churning" equilibrium will be equivalent to $q = 1$.

[45] If, however, $q = 0$ and the "normal" equilibrium condition holds, increasing q is not sustainable since the "low skilled" firm is better off not churning to begin with. Similarly for when the "churning" equilibrium condition actually holds.

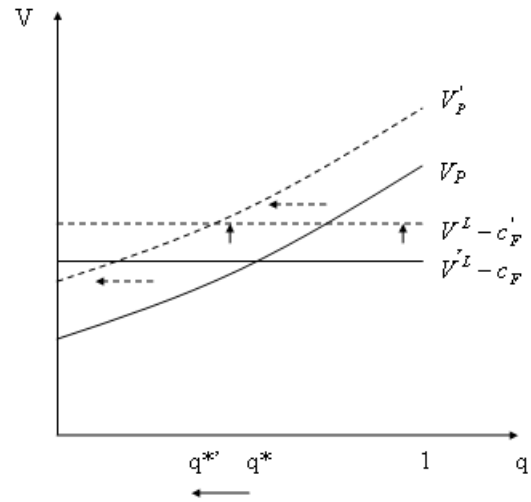

Figure 5.2: Determining the equilibrium value of q

$$
\begin{aligned}
&(\lambda + \frac{1}{T}e^{-\lambda T})f_0^L = \gamma u\,\phi\, m(\theta),\\
&\lambda p_0^L = \frac{1}{T}e^{-\lambda T}(1-q)\, f_0^L,\\
&f_0^L + p_0^L = p - \gamma u.
\end{aligned}
$$

and also

$$
\begin{aligned}
SF_0^L = &\int_0^T \left(\frac{1-e^{-rt}}{r}\pi_L(h) + e^{-rt}(-c_F + U_0)\right) dF_\lambda(T) + \\
&+ e^{-\lambda T}e^{-rT}\left(q(V^L + U_0 - c_F) + (1-q)(V_P^L + P_L)\right)
\end{aligned}
\tag{5.24}
$$

With these changes in mind in the steady state conditions, one can use the free entry conditions ((5.16) and (5.17)) and conditions that determine the cut-off points s_F^H and s_P^H ((5.14) and (5.15)) to find the "mixed" steady state equilibrium.

The "mixed" equilibrium has a very nice real world interpretation. Instead of thinking of a single "low skilled" firm churning with probability q, since we are dealing with a population of such firms we can think of q as the fraction of "low skilled" firms in our economy that never hire their workers on a permanent contract. Workers don't know which type of firm they would meet next time they look for a job and hence their outside option is indeed the one determined in the "mixed" steady state equilibrium.

6 Parametrization and Model Calibration

Given the large number of endogenous variables, we proceed to solve the model for specific sets of parameters instead of solving it analytically. We parametrize the model so that we can simulate the Spanish labor market in the 1990s. In particular we aim to match the data that we have on the unemployment rate, incidence of temporary employment, annual transition rate from temporary to permanent employment, annual transition rate into unemployment. We proceed in the following way:

1. We parametrize the model to annual data.
2. We set the fraction of "low skilled" workers in our economy to $p = .75$. This might seem as a somewhat high proportion but we pick it for our parametrization since the fraction of the Spanish working force population that has a tertiary degree was about 26% in 2005 (EU 2006)[46]. We will consider tertiary education to be a proxy for skill since we do not have data on proportion of workers with a specialized post secondary education or any better proxy for what we call skill level in our model.
3. We normalize the annual output of a "low skilled" job, $\pi_L = 100$, and set the output for a "high skilled" job at $\pi_H(l) = 100$ and $\pi_H(h) = 150$. Thus a "high skilled" job starts with a productivity equal to that of a "low skilled" job but increases to almost 1.5 times this level provided the worker-job match is of high quality. We set the output of a good quality "high skilled" job and worker pair to be 1.5 times that of a "low skilled" job in order to keep the wage rate for a "high skilled" worker on a permanent contract in our model be around 1.5 times that of a "low skilled" worker on a permanent contract which is the observed wage difference between "high skilled" and "low skilled" workers[47].
4. We treat the vacancy costs as free parameters and set $k_L = 150$ which is 1.5 times annual output of a "low skilled" job and $k_H = 250$ at almost double the vacancy cost for a "low skilled" job. This is also consistent with Blanchard and Landier (2002) who

[46] Tertiary education includes any university level degree. These are the International Standard Classification of Education Levels 5 and 6.

[47] The wage rate for a worker with skill parameter a={0, 1} on a permanent contract in our model is $w_P^i = \frac{1}{2}(\pi_i(h) + rU_a + rc_P - V^i(r + \lambda))$, where i={L, H} is the job type.

set the vacancy cost in their parameter to be 2 times annual output of an entry level job[48].

5. We choose a Cobb-Douglas type matching function, $m(u, v) = u^b\, v^{(1-b)}$, where $b = .5$. This is a common choice for a matching function in search theoretic models (Rogerson et al. (2005)).
6. We follow Pries and Rogerson (2005) and set the discount rate r at $r = .04$.
7. We treat the exogenous job destruction rate λ as a free variable and set it at $\lambda = .085$, in order to match the annual job separation rate to the observed value[49].
8. We set $\alpha = 1$ or on average it takes 1 year to learn the match quality between a "high skilled" job and a given worker.
9. We pick a signal distribution which has most of its mass towards zero[50]. Hence, we choose to work with the following density function in our simulation:

$$f_S(s) = 2(1 - s) \tag{6.1}$$

It has an expected value of $E[S] = 1/3$ and also $P(S > 1/2) = 1/4$. Hence for 1/4 of the "high skilled" workers that it meets a "high skilled" firm will assign a probability greater than 1/2 that they will be a good match for the particular job.

We now turn to the policy parameters, the maximum length of a fixed-term contract, T, which captures one dimension of the strictness of FTC regulation (Maximum Number and Duration of FTC), the fixed-term contract cost of dismissal, c_F, which we model as partially capturing the other dimension of FTC regulation strictness (Valid Causes for Use of FTC), and the permanent contract cost of dismissal, c_P, which captures the strictness of permanent EPL in a given country.

1. We set $T = 3$, or 3 years, which is the maximum duration of fixed-term contracts in Spain (OECD (1999));

[48] The average vacancy cost in our model is 2 time the annual output of a "low skilled" or an entry level "high skilled" job with a "low skilled" job having a vacancy cost lower than that average and a "high skilled" job having a vacancy cost higher than that average.

[49] We take this approach, following Pries and Rogerson (2005).

[50] We do this in order to capture the idea that few potential workers for a particular "high skilled" job are initially judged as suitable for that job by the recruitment team of the firm.

2. For the permanent contract dismissal cost we set $c_P = 280$, or almost 2 years worth of a "high skilled" job's output. This might seem as a somewhat high estimate for the dismissal cost, however, up until the labor market reform of 1997, which decreased the payment for unfair dismissal (OECD (2004)), Spain had one of the most strict permanent EPL in place in Europe. Blanchard and Landier (2002) argue that the permanent employment dismissal cost in France for the same period was about 1.5 of average annual output. However, the employment protection legislation in France was less strict at that time than in Spain (OECD (2004)). In Spain, for example, the Unfair Dismissal Compensation at 20 years of tenure, which is awarded to the dismissed worker after an unfair dismissal trial is 22 months pay compared to 15 months pay in France[51].

3. We set $c_F = 20$ which is in the middle of the interval we will be considering for this parameter (we will later vary c_F from 0 to 40). This parameter serves as a partial proxy for the strictness of temporary EPL and differences in it will be comparable to differences in temporary EPL strictness in different countries (based on the OECD index from Section 3). Furthermore, in their simulation of the effects of partial labor reforms Blanchard and Landier (2002) use a dismissal cost for entry level jobs that varies between 1/6 and 1/2 of annual output of an entry level job which is a range comparable to the one we will be using.

Table 6.1 summarizes all the model parameters and the values we assign to each of them in order to simulate the Spanish labor market.

Table 6.2 shows our simulation results and compares them to data on the Spanish labor market (unemployment rate and percentage of temporary employment in 1998 as well as the transition rates from the ECHP (1995-2001) presented in Section 3). The estimates based on the simulation for the four labor market statistics are quite close to the actual data with

[51] The actual legislation change on this matter took place in Spain in 1997, when the maximum compensation for unfair dismissal was decreased from 45 to 33 days per year of service (OECD (1999)). Furthermore, up to the legislation changes in 1997 most of the courts decisions in Spain were against the firm and in favor of the employer in the case of an unfair dismissal lawsuit (with this rate dropping significantly after the legislation changes in 1997) (OECD (1999)). Also, even though unfair dismissal compensation is in effect a transfer payment from the firm to the worker, the presence of wage rigidities make even transfers act like a tax (Garibaldi and Violante (2005). Even though we do not model such wage rigidities their presence in the labor market justifies our treatment of unfair dismissal compensation as a payment to a third party.

Table 6.1: Parameter values used to simulate the Spanish labor market.

Variable	r	α	λ	p	b	π_L	$\pi_H(l)$
Value	0.04	1	0.085	0.75	0.5	100	100
Variable	$\pi_H(h)$	k_L	k_H	$f_S(s)$	T	c_P	c_F
Value	150	150	250	$2(1-s)$	3	280	20

"Temporary to Permanent Transitions" being the farthest from the actual value. However, when one considers estimated transition rates for Spain from other studies (Table 3.2), the model value becomes much more reasonable. The equilibrium that produces these results is a "mixed" equilibrium in which the churning probability, q equals 15%, that is 15% of "low skilled" firms churn in this situation[52].

Table 6.2: Simulation results (left) and labor market conditions in Spain (right)

Variable	**Result based on Simulation**	**Actual Data**
Unemployment Rate	12.5%	15%
Fraction of Temporary Employment	33.1%	33%
Temporary to Permanent Transition (1 year)	17.2%	23.5%
Stay in Employment (1 year)	88.4%	89.8%

Source: Eurostat, Employment in Europe (2004), and author's calculations

7 Numerical Results and Policy Experiments

7.1 Policy Experiments for Spain

We perform a number of policy experiments in order to make a comparison between labor market conditions induced by different policy regimes. We use the parametrization from the previous section and perform the policy experiments by varying the strictness of permanent and temporary EPL, changing the magnitude of T and the two dismissal costs, c_P and c_F[53].

Figure 7.1 shows the results obtained for several labor market statistics of interest, namely the unemployment rate (Figure 7.1a), proportion of fixed-term contracts (Figure 7.1b), transition rate from temporary into permanent employment (Figure 7.1c). Figure A.1 in Ap-

[52]The unemployment rate is lower than the actual value because we implicitly treat the leisure value of a worker to be zero in our model (or value of unemployment benefits to be zero), which leads to a high number of vacancies and hence more matches formed per unit time. If we were to introduce positive value of leisure or positive unemployment benefits the equilibrium unemployment rate in our model would go up.

[53]We perform policy experiments for $T = 2$ and $T = 3$. For each value of T we vary c_P in the range from 120 to 360 in increments of 40 and c_F in the range from 0 to 40 in increments of 20. The lower bound on c_P is chosen so that there will indeed be an equilibrium for any value of c_F. We also assume that $c_P > c_F$.

pendix A shows the results for three other endogenous variables whose behavior is interesting to observe in order to make inferences about the implied firm behavior in each policy experiment (namely, the "churning" probability (Figure A.1a), the fixed-term contract signal cut-off rule (Figure A.1b) and the permanent contract with no information signal cut-off rule (Figure A.1c)).

What is clear from Figure 7.1a is that, according to the model, making fixed-term contracts more flexible to use by decreasing c_F almost halves the unemployment rate for lower levels of permanent EPL. However, this effect is less pronounced for stricter permanent EPL (higher c_P) with the effect actually somewhat reversed for the most stringent permanent EPL considered[54].

The fraction of workers on fixed-term contract is also greatly influenced by how flexible fixed-term employment is compared to permanent employment. Whereas making fixed-term employment completely flexible in the case when the permanent EPL is not so strict ($c_P < 200$) leads to an insignificant increase in the fraction of fixed-term employment (a 5% increase for $c_P = 120$ when c_F goes from 40 down to 0, keeping $T = 3$) that increase is substantially higher the higher the value of c_P (a 53% increase in the case of $c_P = 320$ when c_F goes from 40 down to 0, keeping $T = 3$). The reason for this is that as the two dismissal costs diverge, permanent employment becomes less and less profitable for firms compared to just using temporary employment. Also, whereas "high skilled" firms still find it beneficial to hire workers on permanent contracts, "low skilled" firms readily substitute permanent workers for temporary ones (which is visible from the "churning" probability which increases from 10% to 64% as c_F moves from 40 down to 0 and c_P is fixed at 320, keeping $T = 3$).

The transition rate from temporary to permanent employment also changes significantly as we move towards a more flexible fixed-term EPL. When $c_P = 320$ (permanent EPL is very strict) decreasing c_F from 40 down to 0 more than halves the transition rate from temporary to permanent employment (18.5% versus 9.1%, keeping $T = 3$). There are two causes for this decrease in transition rates. On the one hand, as the FTC dismissal cost decreases, the

[54]For $c_P = 360$, decreasing c_F from 40 to 20 actually increase unemployment rather than decrease it for both $T = 2$ and $T = 3$.

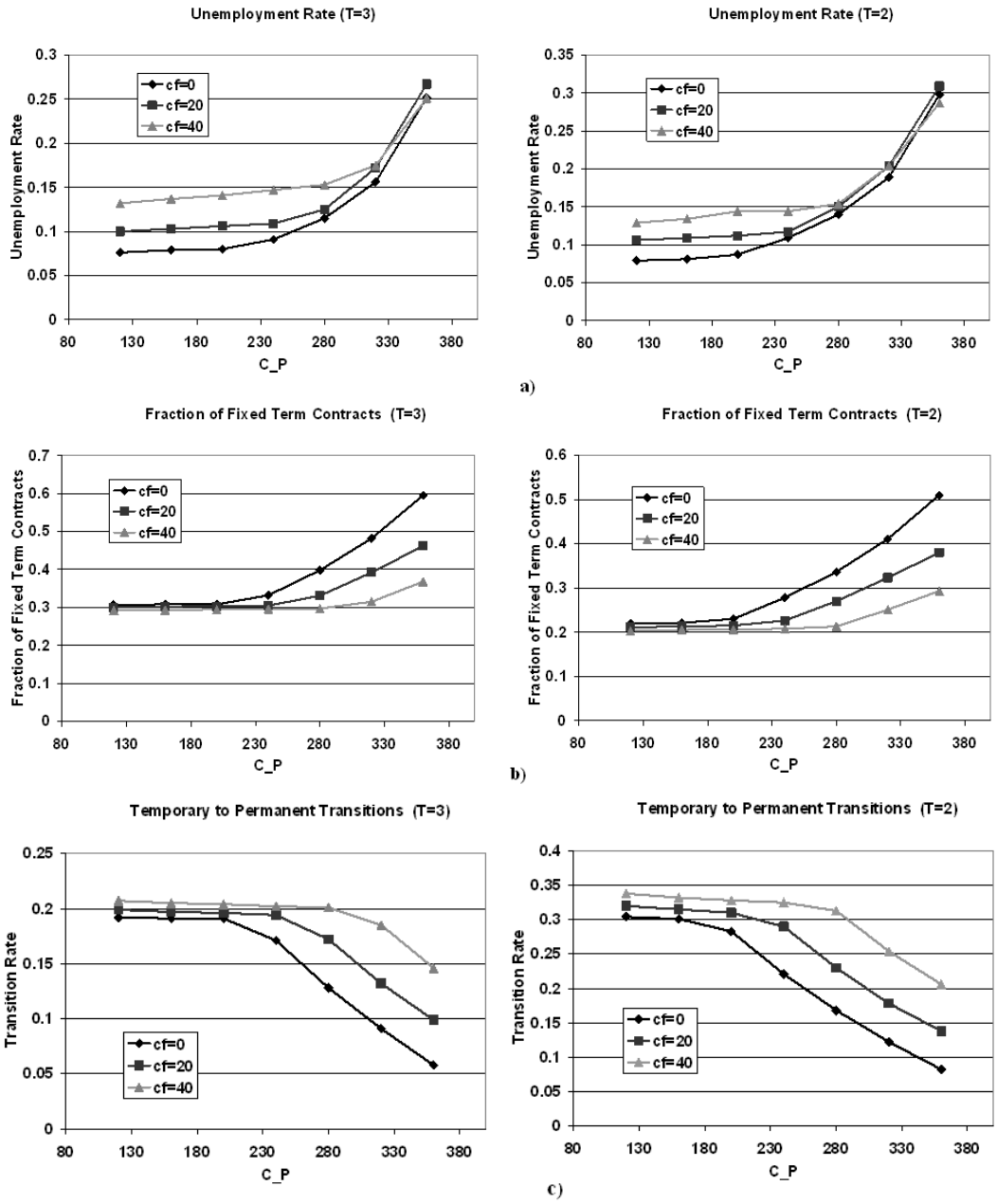

Figure 7.1: Results of policy evaluation experiments for T=3 (left) and T=2 (right); a) Unemployment Rate; b) Fraction of fixed-term contracts; c) Termporary to Permanent transitions.

cost in terms of forgone productivity and dismissal payment that "low skilled" firms have to incur when they don't hire a worker on a permanent contract decreases relative to the permanent contract dismissal cost they would have to incur in the case of a productivity shock, as well as the reduction in profits that they have because of the increased bargaining power of a worker on a permanent contract. Therefore, "low skilled" firms switch to using

temporary workers, with the probability of keeping these workers on a permanent contract gradually decreasing as fixed-term dismissal costs decrease.

"High skilled" firms, on the other hand, which still have a high benefit from keeping a good match on a permanent contract, would also promote a smaller proportion of the workers they hire on a fixed-term contract to a permanent one. The reason for this, however, is different than for the "low skilled" firms. As the fixed-term contract dismissal cost decreases it becomes more profitable for "high skilled" firms to experiment with workers that have a lower probability of being a good match for their job (low signal value) than when FTC dismissal costs are high and hence, on average, would end up with more bad matches than when their experimentation is more limited[55]. This mechanism is also consistent with Nagypal (2002) who looks at the beneficial effects of partially flexible employment protection legislation in terms of allowing firms to experiment with workers they would not usually hire. Experimentation also increases if the fixed-term contract dismissal cost is kept constant and the permanent contract dismissal cost is increased since in this case the relative difference between FTC dismissal cost and the permanent contract dismissal cost increases, and it become more profitable for the "high skilled" firm to hire workers with lower signal values.

The results of the above policy experiments lead us to conclude that during the late 1980s and early 1990s, prior to two labor reform that decreased permanent contract dismissal costs in Spain in 1994 and 1997 (the consequences of which we actually take into account in our parametrization from Section 6) the transition rate from temporary into permanent employment was lower that the observed transition rate in the late 90s and the fraction of temporary employment and unemployment rates were higher. This was indeed the case for these latter two statistics as is evident from Table 3.1.

Lastly, the effects of changing the maximum duration of fixed-term contracts, T (Figure 7.1 - T=3 (left) versus T=2 (right)), are also interesting. While the unemployment rate is slightly affected by such a change (Figure 7.1a)), the fraction of fixed-term contracts and the fixed-term to permanent transitions are significantly influenced by such a change. The reason for this is the specific set-up of our model. Our model assumes that there is no early exit from a fixed-term to a permanent contract, and fixed-term contracts are continued until

[55]The increase in experimentation as the FTC dismissal cost decreases is visible from Figure A.1b.

their legal limit. This, coupled with firms always hiring workers on a fixed-term contract initially, leads to a much lower one year exit rate out of a fixed-term contract when we increase the length of the contract, resulting in both a lower transition rate from temporary to permanent employment but also in a higher incidence of fixed-term employment.

7.2 Cross-Country Comparison

Going back to the discussion in Section 3, we use our model to show how differences in EPL legislation across countries can lead to different labor market conditions. We simulate the labor market conditions in seven European countries: Belgium, France, Germany, Italy, Portugal, Spain and the UK. We do not include the other six countries from Section 3, Austria, Denmark, Finland, Greece, Ireland and the Netherlands because of the specific fixed-term contract legislation in these countries. In these countries, there is no pre-specified maximum duration for fixed-term contracts, which is a problem for our model since the maximum duration of a fixed-term contract in it, T, is an exogenous variable and is not determined endogenously[56]. The UK also has no restrictions on maximum duration of fixed-term contracts. However, for this case, we rely on Booth et al. (2002) who show that the average length of temporary contracts in Britain is ≈ 1 year and set $T = 1.2$[57]. Of course, this is not a legal limit but contract duration, determined by a process that our model cannot capture. Hence, it can serve as an exogenous variable in it. Unfortunately, we cannot do the same for the other six countries mentioned because we do not have information on average length of fixed-term contracts.

Table 7.1 shows information on EPL strictness for these seven countries as well as information on a measure of quality of institutions that we use in order to produce an index of the actual impact of EPL strictness in one country relative to another. This correction for quality of institutions is based on the discussion we had in Section 3 for the Netherlands[58].

Table 7.2 summarizes the results we obtain for the seven countries and compares them to actual labor market statistics for these countries. These results show the general pattern of interaction between fixed-term and permanent contract strictness: a combination of strict

[56]Setting $T = \infty$ is not possible since we effectively deal with an indefinite permanent contract then.

[57]We set $T = 1.2$ instead of $T = 1$ inorder to obtain a positive sorting equilibrium.

[58]It is an average of the Government Effectiveness and Law and Order scores from Kaufmann, Kraay, Mastruzzi (2005). The comments after Table 7.1 provide more details.

Table 7.1: EPL Strictness and Model Specifications for 7 European Countries

	OECD Index (1998)					Model		
Country	**FTC Valid Cases**	**Permanent EPL Strict-ness**	**FTC Max-imum Duration**	**Institutions**	**Effective ELP Strict-ness**	c_F	c_P	**T**
Belgium	2.5	1.7	2.5	1.5	1.7	10	150	2.5
France	1	2.3	1.5	1.5	2.3	30	200	1.5
Germany	2.5	2.7	2	1.8	1.9	10	150	2
Italy	1	1.8	1.25	0.9	2.7	30	280	1.3
Portugal	2	4.3	2.5	1.2	5.4	20	320	2.5
Spain	2	2.6	3	1.5	2.6	20	280	3
UK	3	0.9	no limit	2	0.5	0	50	1.2

Source: OECD (1999), OECD (2004), and Kaufmann, Kraay, Mastruzzi (2005). For first category: 0 - FTC permitted only for "objective reasons" (jobs are temporary in nature); 1 - specific exemptions apply (launching a new activity, worker starts new job); 2 - exemptions exist on both the employer and employee side; 3 - no restrictions. Institutions = Average of Government Effectiveness and Law and Order. Effective ELP Strictness = $\frac{1.1+\Delta Institutions}{1.1}(PermanentEPLStrictness)$, where $\Delta Institutions$ is the difference in the institutional variables of the given country and Spain. 1.1 is the difference between the lowest and the highest Institutions score.

fixed-term and permanent contract legislation leads to a higher unemployment rate, but a lower percentage of fixed-term contracts and higher transition rates from temporary into permanent employment as in the case of Italy. In Spain and Portugal, on the other hand, a combination of partial deregulation of fixed-term contracts and strict permanent EPL leads to the high percentage of fixed-term contracts and a lower transition rate. In the UK, flexible fixed-term and permanent employment protection legislation cause lower unemployment, a low fraction of fixed-term contracts and a high transition rate. The other three countries are in an intermediate position between the above three.

The model makes good predictions for some countries but is somewhat inaccurate for others[59]. In general we see that the model slightly overstates the fraction of fixed-term contracts in an economy and understates the transition rate from temporary to permanent employment. The reason for this is that the set-up of the model is such that the fraction of fixed-term contracts signed cannot fall below a certain threshold. This is so because we assume that any worker is always hired on a fixed-term contract first before the firm decides whether to hire them on a permanent contract or not. Furthermore, fixed-term contracts

[59]For France, one explanation that we gave in Section 3 could be that temporary work there is indeed aimed for jobs that are not permanent in nature. Another reason could be the uncertainty about the actual transition rates from temporary to permanent employment given the variation observed when looking at other studies (Table 3.2).

Table 7.2: Labor Market Statistics and Simulation Results for 7 European Countries

	Labor Market Statistics (1998)			**Model**		
Country	**Unempl. Rate (%)**	**Fixed-term Contracts (%)**	**Temporary to Permanent Transition (%)**	**Unempl. Rate (%)**	**Fixed-term Contracts (%)**	**Temporary to Permanent Transitions (%)**
Belgium	9.3	8.2	41.7	9	26.8	23.3
France	11.1	13.9	20.7	12	16	44.8
Germany	8.8	12.4	37.2	8.5	21	32
Italy	11.3	8.6	30.6	16.5	17.8	39.4
Portugal	5.1	17.2	29.4	18.3	34.8	15.9
Spain	15	33	23.5	12.5	33.1	17.2
UK	6.1	7.3	44.5	7.7	13.9	55.4

Source: Eurostat and Employment in Europe (2004). Parametrization: $r = 0.04$, $\alpha = 1$, $\lambda = .085$, $\pi_H(0) = 100$, $\pi_L = 100$, $k_L = 150$, $k_H = 250$ for all countries. For Belgium: $p = 0.73$, $\pi_H(h) = 160$, for France: $p = 0.77$, $\pi_H(h) = 160$, for Germany: $p = 0.79$, $pi_H(h) = 160$, for Italy: $p = 0.9$, $\pi_H(h) = 175$, for Portugal: $p = 0.9$, $\pi_H(h) = 150$, for Spain: $p = 0.75$, $\pi_H(h) = 150$, for UK $p = 0.74$, $\pi_H(h) = 150$. The parameter p is determined based on fraction of working age population with tertiary degree in a given country (Employment in Europe 2006). Productivity parameter $\pi_H(h)$ is set as close as possible to $\pi_H(h)$ for Spain but at a value that results in a positive sorting equilibrium.

last until the maximum legal length, while in reality a significant proportion of fixed-term contracts are signed for periods shorter than that maximum duration. Also workers do not search on the job[60] and do not have a preference for a permanent contract, which they do in reality, since a permanent contract provides protection against temporary productivity shocks exactly because of the dismissal costs associated with it[61].

A number of these features can be changed in subsequent future work or in possible extensions of the model. Nevertheless, despite these shortcomings, the model still captures the general pattern of the influence of temporary and permanent employment protection legislation on the labor market and provides a framework for basic employment protection policy analysis and analysis of cross country differences in labor market conditions.

8 Conclusion

The aim of our study was to show how deregulating fixed-term employment contracts while keeping the protection on traditional forms of employment fixed may give mixed results in

[60] In reality workers perform on-the-job search, which gives them a higher bargaining power.

[61] In our model there are no temporary productivity shocks and once a shock hits, the job is destroyed, prompting the firm to fire the worker no matter what the dismissal cost is.

a stagnant labor market. Although the ambiguous effects of partial labor reform have been explored before, we propose a novel mechanism for how this occurs. Taking into account job and worker heterogeneity, we show that firms respond to a partial deregulation of fixed-term contracts differently, depending on the types of jobs they create. For jobs in which a good match with the worker entails a large gain in productivity (the "high skilled" jobs in our model), firms use fixed-term contracts to screen workers, allowing them to experiment without paying a high dismissal cost if the worker is not a good match. In this case a partial deregulation of fixed-term contracts would be beneficial. For jobs in which match quality is less important ("low skilled" jobs), fixed-term contracts provide flexibility against potential productivity shocks rather than serve a screening purpose. As a result, when the fixed-term contract dismissal cost is low and the permanent contract cost is high "low skilled" firms preventively destroy good matches by not hiring workers on permanent contracts and keeping jobs that are permanent in nature filled with temporary workers.

Thus the differential impact on the career prospects of workers on different kinds of jobs is the main consequence of this mechanism. Workers in "high skilled" jobs would experience a smaller change in the transition probability from temporary into permanent employment compared to workers in "low skilled" jobs. As a result, a partial reform segments the labor market, so certain groups of the working age population get hired only on fixed-term contracts with little hope for getting a permanent job. We have not dealt with direct evidence for this and have focused more on the aggregate effects of partial deregulation of fixed-term contracts when this mechanism is taken into account. We considered a set of policy experiments and the effects that each of them would have on labor market conditions. We also attempted to see how such a mechanism can create cross-country variation in labor market conditions similar to what we observe in reality.

There is a more direct way to test whether the mechanism proposed in our model is economically significant. Assuming that workers with different observable characteristics are more likely to be in a certain type of job (positive sorting), one could test the presence of this effect by looking at the change in transition probabilities for workers with different observable characteristics before or after the introduction of such a partial reform. Alternatively, one could look at differences of transition probabilities of workers with common observable

characteristics across countries with different employment protection legislation rules[62].

Another direction for further research on this topic could be the analysis of the welfare impact of different employment protection policy regimes. Such an analysis would bring the discussion towards the question of optimal design of employment protection legislation. As a further extension we could relax our model assumptions regarding the positive sorting restrictions and the lack of on-the-job search on the side of workers. This would allow for temporary mismatches between workers and jobs of different types, a common phenomenon in the labor market (Dolado et al. (2004)). Allowing for voluntary quits of workers would change both the way a partial reform affects the labor market and the differential impact of such a reform on workers with different skill levels.

Appendix A

Value functions

We first show how to derive the value functions for firms and workers. We will explicitly show the derivation of one of them since the rest are derived in an analogous manner. We derive the vacancy value of a "high skilled" job: We use a continuous time version of the Bellman equation: $rF(x,t) = max\{\pi(x,u,t) + \frac{1}{dt}E[dF]\}$ (Dixit and Pindyke, 1994), where $F(x,t)$ is the maximized value function in state x and at time t, $\pi(x,u,t)$ is the rate of the profit flow at time t, u is the control variable. $E[dF]$ refers to the expected changed in the value function during the interval dt. The intuition of the above equation is the following, if we think of $F(x,t)$ as the value of an asset, we have that the asset return equals the dividend flow plus expected capital gain. We then have that

$$
\begin{aligned}
&rV^H = max\{0 + \frac{1}{dt}E[dV^H]\} = \\
&= \frac{1}{dt}(\rho_1 dt \int_0^1 \left(max\{V_F^H(s,1), V^H\} - V^H\right) dF_S(s) + (1-\rho_1 dt)(V^H - V^H)) = \\
&= \rho_1 \int_0^1 max\{V_F^H(s,1) - V^H, 0\} dF_S(s)
\end{aligned}
$$

[62] This would also require quantifying the dismissal costs associated with a particular employment protection legislation in a given country providing a more solid foundation for cross country comparisons of employment protection legislation strictness.

In the above expression the expectation is taken with respect to the probability distribution of meeting a "high skilled" worker (which has a constant rate per unit time of ρ_1) and conditional on that with respect to the distribution of the signal value S. The derivation of the other value functions is analogous.

Value of a fixed-term contract $V_F^H(s,1)$

We now derive the value of a fixed-term contract to a "high skilled" firm. We have that T_α is the time of the realization of match quality and T_λ is the time a productivity shock hits. There are four possibilities for the relationship between T, T_α and T_λ: $min\{T_\alpha, T_\lambda\} > T$, $T_\alpha < T < T_\lambda$, $T_\alpha < T_\lambda < T$, and $T_\lambda < T_\alpha$ and $T_\lambda < T$. The value of a fixed-term contract would differ depending on which of these four realizations of T_α and T_λ occur. In particular, if $V_F^H(s,1)$ is the value to a "high skilled" firm of hiring a "high skilled" worker on a fixed-term contract when the signal observed is s, we have that

$$E[V_F^H(s,1)|min\{T_\alpha, T_\lambda\} > T] = \frac{1-e^{-rT}}{r}\left(\pi_H(l) - w_F^H(s,1)\right) + e^{-rT} max\{V_P^H(s,1), V^H - c_F\};$$

$$P(T_\alpha < T)E[V_F^H(s,1)|T_\alpha < T < T_\lambda] =$$

$$= s\int_0^T \left(\frac{1-e^{-rt}}{r}\left(\pi_H(l) - w_F^H(s,1)\right) + \frac{e^{-rt}-e^{-rT}}{r}\left(\pi_H(h) - w_F^H(s,1)\right)\right) dF_\alpha(t) +$$

$$+ F_\alpha(T)(1-s)\frac{1-e^{-rT}}{r}\left(\pi_H(l) - w_F^H(s,1)\right) + F_\alpha(T)e^{-rT}\left(sV_P^H(h) + (1-s)V^H\right);$$

$$P(T_\alpha < T_\lambda < T)E[V_F^H(s,1)|T_\alpha < T_\lambda < T] = s\int_0^T\int_t^T [\frac{1-e^{-rt}}{r}\left(\pi_H(l) - w_F^H(s,1)\right) +$$

$$+ \frac{e^{-rt}-e^{-rx}}{r}\left(\pi_H(h) - w_F^H(s,1)\right) + e^{-rx}(-c_F)]dF_\lambda(x)F_\alpha(t) +$$

$$+ (1-s)\int_0^T\int_t^T \left(\frac{1-e^{-rx}}{r}\left(\pi_H(l) - w_F^H(s,1)\right) + e^{-rx}(-c_F)\right) dF_\lambda(x)\, dF_\alpha(t);$$

$$P(T_\lambda < T_\alpha, T_\lambda < T)E[V_F^H(s,1)|T_\lambda < T_\alpha, T_\lambda < T] =$$

$$= \int_0^T \left(\left(\frac{1-e^{-rt}}{r}\left(\pi_H(l) - w_F^H(s,1)\right) + e^{-rt}(-c_F)\right)(1 - F_\alpha(t))\right) dF_\lambda(t).$$

For the first expression, we assume that the firm, upon having no information about the match quality when the fixed-term contract expires, decides on whether to hire the worker on a permanent contract, and wait until it learns the actual match quality, and then act accordingly, or lay the worker off and search for a new one. The second expression above

is derived by considering the two cases when the match is good and the match is bad. As we mentioned in Section 4.2 in the first case we assume that the firm continues paying the worker $w_F^H(s,1)$. In the second case, when match quality turns out to be bad, we assume that the firm keeps the worker until the end of the fixed-term contract. The third expression considers the somewhat tricky case when the firm learns the quality of the match before a productivity shock hits but both these events occur before the end of the fixed-term contract. In this case, the firm lays off the worker as soon as the productivity shock hits. In the fourth case, the firm again lays off the worker as soon as the productivity shock hits.

Having these conditional expected values for the value of a fixed-term contract we can derive the unconditional expectation which we will simply consider as a function of the signal s later on. We have that

$$
\begin{aligned}
&V_F^H(s,1) = e^{-(\lambda+\alpha)T} E[V_F^H(s,1)|min\{T_\alpha, T_\lambda\} > T] + \\
&+ e^{-\lambda T} P(T_\alpha < T) E[V_F^H(s,1)|T_\alpha < T < T_\lambda] + P(T_\alpha < T_\lambda < T) E[V_F^H(s,1)|T_\alpha < T_\lambda < T] + \\
&+ P(T_\lambda < T_\alpha, T_\lambda < T) E[V_F^H(s,1)|T_\lambda < T_\alpha, T_\lambda < T] = \\
&= A_1^H(s) + e^{-\lambda T}(1 - e^{-\alpha T}) e^{-rT} \left(s\, V_P^H(h,1) + (1-s)\left(V^H - c_F\right)\right) + \\
&+ e^{-(\lambda+\alpha)T} e^{-rT} max\{V_P^H(s,1), V^H - c_F\}.
\end{aligned}
$$

The derivation of the expression for the value to a worker of a fixed-term contract is analogous. Again we have the same four cases as above, each of which would result in a different expression for $F_1^H(s)$.

Steady State Equations for "Normal" Equilibrium

We define f_0^L, p_0^L to be the steady state measure of "low skill" workers on a fixed-term, and permanent contracts for "low skill" jobs. Similarly for "high skilled" workers we have f_1^H, p_1^H and p_1^{H*} are the measures of "high skill" workers on a fixed-term, permanent, and permanent contract with no information about match quality. We have to split the permanent contract state into two states because each of them has different transition rates in and out of them.

We then have the following system of equations hold for the steady state conditions for the "low skilled" workers in a "normal" equilibrium:

$$(\lambda + \frac{1}{T}e^{-\lambda T})f_0^L = \gamma u\, \phi\, m(\theta)$$
$$\lambda p_0^L = \frac{1}{T}e^{-\lambda T} f_0^L$$
$$f_0^L + p_0^L = p - \gamma u$$

For the "high skilled" workers we have the following steady state equations:

$$(\lambda + \frac{1}{T}e^{-\lambda T})f_1^H = (1-\gamma)u\,(1-\phi)m(\theta)\,(1 - F(s_F^H))$$
$$(\lambda + \alpha)p_1^* = \frac{1}{T}e^{-\lambda T}\, e^{-\alpha T}(1 - F(s_P^H))f_1^H$$
$$\lambda p_1 = \alpha\, E[s|s \geq s_P^H]p_1^* + \frac{1}{T}e^{-\lambda T}(1 - e^{-\alpha T} E[s|s \geq s_F^H]\, f_1^H$$
$$f_1^H + p_1^* + p_1 = (1-p) - (1-\gamma)u$$

We have a system of 7 equations in 9 unknowns, therefore we can express 7 of our endogenous variables in terms of the other two.

The surplus function $SP_1^H(s)$

From the expression for $SP_1^H(s)$ (Eq. (5.8)) we can determine its exact value. We have

$$SP_1^H(s) = \frac{1}{r+\lambda+\alpha}(\pi_H(l) + \lambda(U_1 - c_P) +$$
$$+ \frac{\alpha s}{r+\lambda}\,(\pi_H(h) + \lambda(U_1 - c_P)) + \alpha(1-s)(U_1 - c_P + V^H)) - V^H - (U_1 - c_P).$$

We observe that $SP_1^H(s)$ is linear in s and that

$$\frac{d}{ds}SP_1^H(s) = \frac{\alpha}{r+\lambda+\alpha}\left(\frac{\pi_H(h) - \lambda(U_1 - c_P)}{r+\lambda} - (U_1 - c_P) - V^H\right) = \frac{\alpha}{r+\lambda+\alpha}S_1^H > 0$$

Hence, $SP_1^H(s)$ is increasing in s and so the cut-off point s_P^H is unique. Given that $SP_1^H(s_P^H) = 2\,(c_P - c_F)$, another expression for $SP_1^H(s)$ would be

$$SP_1^H(s) = (s - s_P^H)\frac{\alpha}{r+\lambda+\alpha}S_1^H + 2\,(c_P - c_F)$$

The surplus function $SF_1^H(s)$

We have that

$$SF_1^H(s) = V_F^H(s,1) + F_1^H(s) - (V^H - c_F) - U_1$$

which if we use the expressions for $V_F^H(s,1)$ and $F_1^H(s)$ from above is equivalent to

$$SF_1^H(s) = K + s\,P(T_\lambda > T)\int_0^T \frac{e^{-rt}-e^{-rT}}{r}\Delta\pi_H dF_\alpha(t)+$$
$$+\,s\int_0^T\!\!\int_t^T \frac{e^{-rt}-e^{-rx}}{r}\Delta\pi_H dF_\lambda(x)dF_\alpha(t) + s\,P(T_\alpha < T < T_\lambda)(S_1^H - c_P)+$$
$$+\,P(T<T_\alpha)P(T<T_\lambda)e^{-rT}\begin{cases} SP_1^H(s) - c_P + V^H - c_F + U_1 + c_F, & s \geq s_P^H \\ V^H - c_F + U_1, & s \geq s_P^H \end{cases}$$

In the above expression K does not depend on s. Also we can take out a $P(T<T_\alpha)P(T<T_\lambda)e^{-rT}(V^H - c_F + U_1)$ from the last part of the expression since it's present both when $s \geq s_P^H$ and $s \geq s_P^H$. We then have the following expression which is independent of s

$$K + P(T<T_\alpha)P(T<T_\lambda)e^{-rT}(V^H - c_F + U_1) =$$
$$= e^{-\lambda T}\frac{1-e^{-rT}}{r}\pi_H(l) + e^{-\lambda T}e^{-rT}(V^H - c_F + U_1) + \int_0^T\!\!\int_t^T \frac{1-e^{-rx}}{r}\pi_H(l)dF_\lambda(x)dF_\alpha(t)+$$
$$+\,(U_1 - c_F)\int_0^T\!\!\int_t^T e^{-rx}dF_\lambda(x)dF_\alpha(t) + \int_0^T \frac{1-e^{-rt}}{r}\pi_H(l)(1-F_\alpha(t))dF_\lambda(t)+$$
$$+\,(U_1 - c_F)\int_0^T e^{-rt}(1-F_\alpha(t))dF_\lambda(t) + V^H - c_F + U_1$$

Hence, $SF_1^H(s)$ is linear function of s for $s \leq s_P^H$ with slope G

$$G = \Delta\pi_H[P(T_\lambda > T)\int_0^T \frac{e^{-rt}-e^{-rT}}{r}\,dF_\alpha(t) + \int_0^T\!\!\int_t^T \frac{e^{-rt}-e^{-rx}}{r}\,F_\lambda(x)dF_\alpha(t)]+$$
$$(+1 - e^{-\alpha T})e^{-\lambda T}e^{-rT}(S_1^H - c_P + c_F)$$

Using this observation, the fact that $s_F^H < s_P^H$, and equation (5.7) together with the above derivation for $SP_1^H(s)$ we derive an alternative expression for $SF_1^H(s)$, which does not involve K. We have that

$$SF_1^H(s_F^H) = s_F^H\,G + K + P(T<T_\alpha)P(T<T_\lambda)e^{-rT}(V^H - c_F + U_1) = 2\,c_F$$

Hence,
$$-s_F^H\,G + 2\,c_F = K + P(T<T_\alpha)P(T<T_\lambda)e^{-rT}(V^H - c_F + U_1)$$

Substituting for $K + P(T<T_\alpha)P(T<T_\lambda)e^{-rT}(V^H - c_F + U_1)$ in the original expression for $SF_1^H(s)$ leads to the final expression

$$SF_1^H(s) = (s - s_F^H)\,G + I(s \geq s_P^H)e^{-(\lambda+\alpha)T}e^{-rT}(SP_1^H(s) - c_P + c_F) + 2\,c_F$$

From the above expression we can see that $SF_1^H(s)$ is also linear in s. However, the graph of $SF_1^H(s)$ will be kinked at s_P^H whenever $s_P^H < 1$ since the slope of $SF_1^H(s)$ will increase by the slope of $SP_1^H(s)$ times a discounting factor after that point.

Positive Sorting Condition

Lastly we derive the condition for a positive sorting equilibrium according to which "high skilled" workers would not accept "low skilled" jobs. This means that the value to a "high skilled" worker from accepting a "low skilled" job is lower than the worker's unemployment value. If we let V_F^L be the value to a "low skilled" firm from hiring a "high skilled" worker on a fixed-term contract, F_1^L be the value to a "high skilled" worker of accepting a "low skilled" job, and SF_1^L be the joint surplus from a "high skilled" worker - "low skilled" pair under a fixed-term contract then we have that

$$F_1^L < U_1 \iff F_1^L - U_1 < 0 \iff SF_1^L < 0 \iff$$
$$\iff V_F^L + F_1^L - V^L + c_F - U_1 < 0$$

This last expression is equivalent to

$$\pi_L \int_0^T \frac{1-e^{-rt}}{r} dF_\lambda(t) + (U_1 - c_F) \int_0^T e^{-rt} dF_\lambda(t) +$$
$$+ e^{-\lambda T} e^{-rT} ((1-q)\frac{\pi_L + \lambda U_1 - \lambda c_P}{\lambda + r} + q(U_1 + V^L - c_F)) - V^L + c_F - U_1 < 0$$

Table A.1: A list of commonly used model variables and parameters

Variable	Description
p	Fraction of "low skilled" workers in the economy
$\pi_L(h)$	Productivity flow of "low skilled" job, $\pi_L(h) = \pi_L$
$\pi_H(l)$	Productivity flow of "high skilled" job when worker is not a good match or when match quality has not been learned yet
$\pi_H(h)$	Productivity flow of "high skilled" job when the match is good
s	A particular signal value realization
r	Instantaneous discount rate
α	Rate of learning
λ	Rate of productivity shock
k_i	Vacancy cost of a job of type i, $i = \{L, H\}$
q	Churning probability
c_F	Fixed-term contract dismissal cost
c_P	Permanent contract dismissal cost
T	Maximum duration of fixed-term contract
ϕ	Fraction of "low skilled" job vacancies
γ	Friction of unemployed "low skilled" workers
$m(u, v)$	Matching function
u	Unemployment rate
v	Measure of job vacancies
ψ^i	Rate of meeting job vacancies of type $i = \{L, H\}$
ρ_a	Rate of meeting a worker of type $a = \{0, 1\}$
V^i	Value of a vacant job to a firm posting a job of type $i = \{L, H\}$
V_F^L	Value to a "low skilled" firm of hiring a worker on a fixed-term contract
V_P^L	Value to a "low skilled" firm from hiring a worker on a permanent contract
$V_F^H(s, 1)$	Value to a "high skilled" firm of hiring a "high skilled" worker on a fixed-term contract after observing a signal value of s
$V_P^H(., 1)$	Value to a "high skilled" firm of hiring a "high skilled" worker on a permanent contract after observing a signal value of s
$V_P^H(y, 1)$	Value to a "high skilled" firm of hiring a "high skilled" worker on a permanent contract after it learns the match quality $y = \{l, h\}$
U_a	Value to a worker of skill level a of being unemployed
F_0^L	Value to a "low skilled" worker of being employed on a fixed-term contract by a "low skilled" firm
$F_1^H(s)$	Value to a "high skilled" worker of being employed on a fixed-term contract by a "high skilled" firm given a signal value of s
P_0^L	Value to a "low skilled" worker of being employed on a permanent contract by a "low skilled" firm
$P_1^H(.)$	Value to a "high skilled" worker of being employed on a permanent contract by a "high skilled" firm given a either signal value of s
SF_0^L	Surplus function for fixed-term bargaining stage between "low skilled" firm and worker
$SF_1^H(s)$	Surplus function for fixed-term bargaining stage between "high skilled" firm and worker given a signal value of s
S_a^i	Surplus function for permanent contract bargaining stage between worker of type $a = \{0, 1\}$ and firm of type $i = \{L, H\}$
s_F^H	Fixed-term contract cut-off point
s_P^H	Permanent contract cut-off point

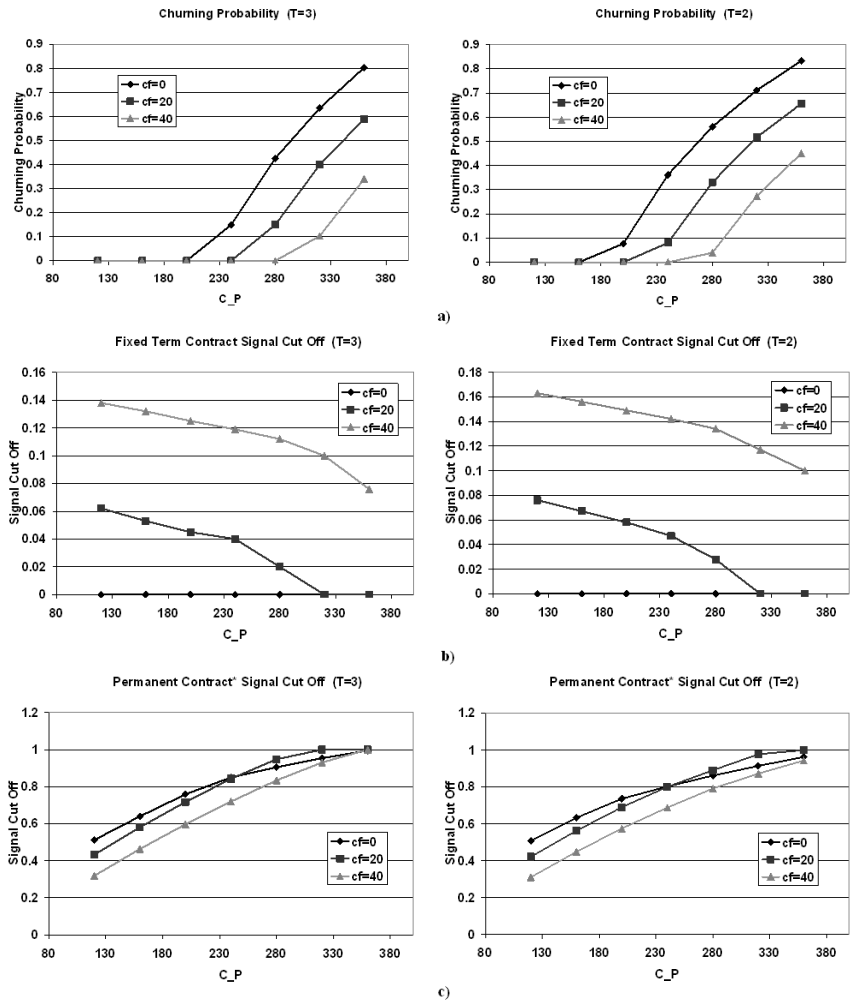

Figure A.1: Results of policy evaluation experiments for T=3 (left) and T=2 (right); a) Churning probability; b) FTC cut-off; c) Permanent (no info) cut-off.

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